# CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 25 San Francisco, January, 1939 Number 1

# STATE OF CALIFORNIA
## DEPARTMENT OF NATURAL RESOURCES
### DIVISION OF FISH AND GAME
San Francisco, California

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# PROGRESS REPORT ON TAGGING PACIFIC MACKEREL [1]

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In 1928 the canning of Pacific mackerel suddenly became a large industry operating on the well-established American plan which assumes all natural resources are inexhaustible until they are practically exhausted. The southern California sardine canners and their fleets of boats discovered that there was good money to be made from mackerel. In the resulting scramble for fish, mackerel were taken with absolutely no regard for the future supply, and already the fishery is in a very serious condition. The fishermen can not catch fish in anything like the former quantities in spite of the fact that they are using bigger boats, are scouring a much larger area and have the added incentive of a higher price.

Even before the crash came, it was obvious that some well thought out plan of management would soon have to be put into effect. Tracing the movements of the fish is an important part of the research on which such a plan must be based. Pacific mackerel are caught in large quantities only in southern California and the extreme northern part of Lower California (Point Conception, California, to Ensenada, Lower California—a distance of about 260 miles). During the past few years the quantities taken have been many times what such a limited area could be expected to produce—and if southern California is not producing its own fish, where are they coming from? The approximate range of the species is from Vancouver Island, British Columbia, to the tip of Lower California—a distance of nearly 2000 miles. (See Fig. 1.) From how much of this range are the fish moving into southern California waters? There are other important questions relating to mackerel migrations. For example: There is known to be much heavier spawning off Lower California than off California. Does a large part of our mackerel population go south to spawn, or does Mexico have a much larger supply of fish? If the latter is true, can we expect Mexican fish to move north as ours are fished out? To put it another way—if we destroy our own fish, will more move in from somewhere else, will there be other populations to the north and south which will not move in, or will we have depleted the mackerel supply of the entire Pacific Coast? To answer these vital questions, a mackerel tagging program has been under way since July, 1935.

[1] *Pneumatophorus diego.* Submitted for publication, November, 1938. A shorter report on the same subject was published in CALIFORNIA FISH AND GAME, April, 1937. Parts of this earlier paper are repeated here to make the present report complete and to spare the reader the annoyance of being referred to an article which he probably does not have.


FIG. 1. Range, area of heavy fishing and known spawning areas of the Pacific mackerel. The range is roughly from Vancouver Island to the tip of Lower California. The waters of the Gulf of California are too warm for mackerel.

65935—Between pages 2-3

Tagging consists of fastening to the fish some sort of tag, band or label, turning it loose, and waiting for someone to report where it was next seen. If the movements of enough individuals can be checked in this manner, it is possible to obtain very definite knowledge of the movements of the entire race.

Along the Pacific Coast there are two methods of finding tagged fish. The obvious way is for some fisherman to notice the tag on one of his catches and take or send it to the organization carrying on the investigation. This method is fairly satisfactory in the case of mackerel, because numbers of these fish are caught by sportsmen and market fishermen who would be apt to see the tags. A more recent method is to use magnetic tags and recover them with magnetic collectors. This method is more likely to get the tags from those mackerel which are delivered to the canneries, since the packers take fish in such quantities that neither the fishermen nor the cannery workers look closely at any individual.

When the California Division of Fish and Game started its sardine tagging program, magnets for tag recovery were installed in canneries and reduction plants all over the State. The magnets were not absolutely essential to the mackerel program, but since they were already being installed for sardine work, there was every reason to take advantage of them, so the mackerel tags were made of magnetic material.

As an inducement to fishermen to let us have any tagged mackerel they may take, we are offering 75 cents for the return of each fish with tag in place, or 50 cents for the tag alone. Full information as to where and when the fish was taken must accompany the tag. Fish or tag may be taken to the California State Fisheries Laboratory, Terminal Island, or the San Diego or Monterey offices of the Division of Fish and Game, or the tag may be mailed to the California State Fisheries Laboratory. By offering the extra 25 cents for the fish, we have been able to keep track of the way in which the tags are staying in place, and we may eventually accumulate some valuable information on growth rate. Illustrated notices are posted in most places where fishermen are apt to land mackerel, such as canneries, markets and pleasure fishing piers.

## Types of Tags Used

### External Tags

The type of tag originally chosen is shown in figure 2. It is of the strap type and is designed to fasten onto the gill cover. It is applied with a special pair of pliers. When closed the tag measures about 3 mm. wide by 17 mm. long ($\frac{1}{8}$ inch by a bit over $\frac{5}{8}$ inch). One side carries a serial number, the other is inscribed "C. F. & G."

Up to the present time we have not been able to obtain nickel strap tags which were satisfactory for use as delivered. They have all had a sharp wire edge. At first, in desperation, we used them regardless and soon obtained definite proof that they were very irritating to the fish and in many cases rapidly enlarged the hole in the gill cover and dropped off.

In October, 1936, we started the practice of smoothing strap tags before use. At first, this was done by hand, but the process was too slow, so after a bit of experimenting, we developed a better method. A

drum, 9 inches in diameter by 2 feet long, was given a longitudinally ridged inside surface and lined with fine emery cloth. The ridges were made by nailing 16 strips of ¾-inch half round pine on the inside of the drum. The device is loaded with a batch of tags and revolved at 55 r.p.m. After four to eight hours, the tags are in excellent condition. The maximum operating capacity of the drum is probably about 5000 tags.

The tags stay on a great deal better if they are smoothed. The maximum time between tagging and recovery for wire-edged tags was about four months. The three longest periods were 71, 122 and 124 days. The smoothed tags have already beaten that 124-day "record"

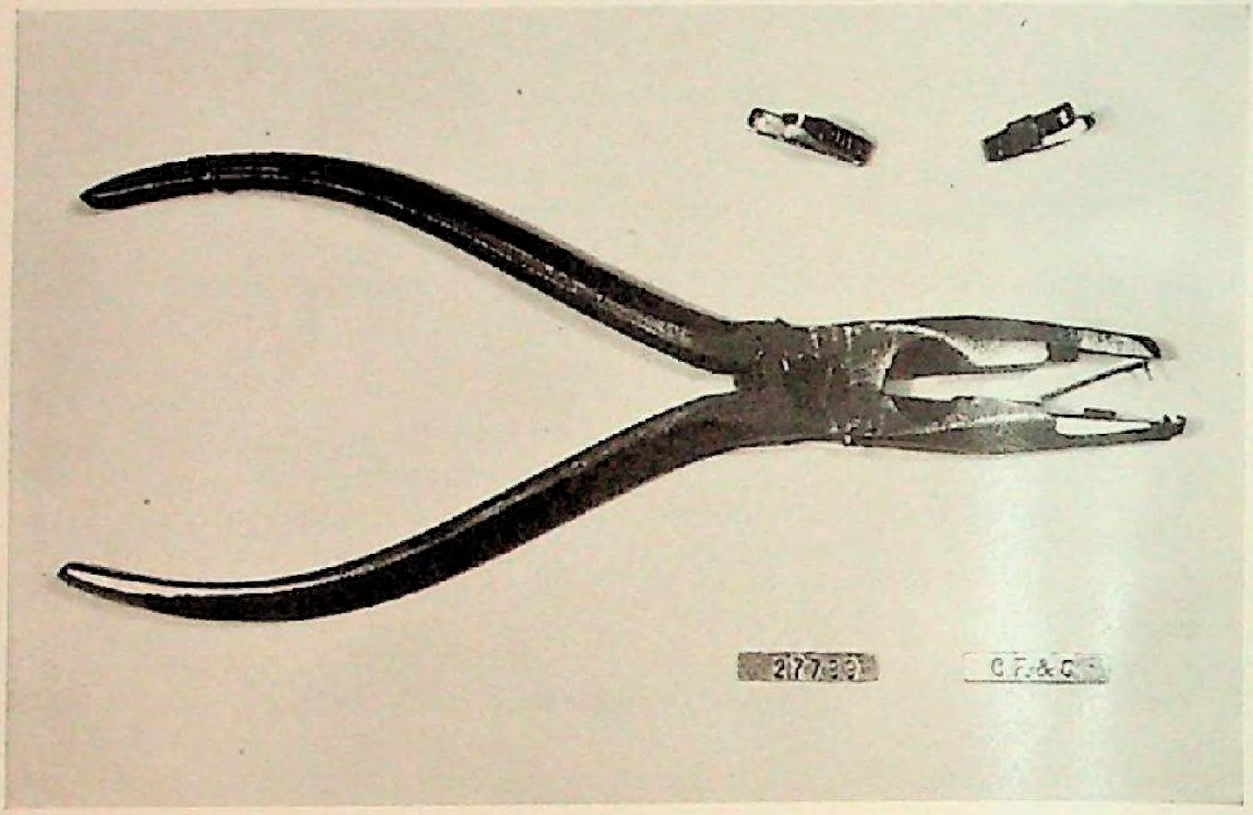

FIG. 2. Mackerel tags and tagging pliers. The strap tags shown at the top are clinched into the gill cover of the fish with the pliers. The pliers force the point of the tag through the gill cover, through the hole in the other end of the tag, and bend it over. The pliers are quite simple but must be accurately made if they are to work properly. A tag is shown in the pliers, ready to apply. The internal tags, shown below, are inserted into the body cavity of the fish through a small slit made in its side. The internal tags are used for both sardines and mackerel.

on 21 different occasions, and two of these tags were out approximately one year. About 2200 fish have been tagged with rough tags and about 6300 with smooth. Neither figure includes a batch of 1000 monel metal tags with which we did our first experimenting.

### Internal Tags

Two things were done when it became apparent that the unsmoothed external tags were not satisfactory. One (smoothing the tags) has just been discussed. The other was to experiment with internal tags—supposedly the most enduring type of mark yet devised.

Our internal tags (also shown on figure 2) are flat pieces of metal which are slipped into the body cavity of the fish through a tiny slit

made in its side. Being inside the fish they are not readily noticed, hence we must use magnetic tags and depend on cannery magnets for our recoveries. The permanency of the tags makes them suitable for tracing long migrations, but they are very unsatisfactory for tracing short movements. The magnets in use in California do not recover the tags until the fish heads and offal have been made into meal. The delay makes it impossible to learn what boat took the fish, or where it was taken—but we do know the territory covered by the boats operating out of each port, and we can place the recovery within that area.

The internal tags used for mackerel tagging are the same as those used on sardines. They are of nickel-plated steel, 19 by 4 by 0.7 mm. ($\frac{3}{4}$ by $\frac{5}{32}$ by $\frac{1}{36}$ inch). One side is numbered, the other is inscribed either "C. F. & G." or "CALIF."

#### Relative Permanency of Internal and Polished External Tags

When we started using the internal tags we assumed that they would be far more permanent than the external ones which we had just polished. The external tags then fooled everyone by making a far better showing than we had expected. After more time has passed, the internal tags may show definite proof of greater permanency, but at present there is only the barest hint of such superiority.

No separation of the returns by type of tag has been made in this paper. To have done so properly would have required a very detailed analysis of results, and at present it seems more advisable to wait till the results really mean something.

## Tagging Methods

#### Boats Used

Mackerel tagging has been done from many sizes and types of boats from 16 to 86 feet long. Sixteen- to twenty-footers are makeshifts for this sort of work—there isn't enough room in them. On the other hand a pair of small boats when used together make a perfectly satisfactory unit in smooth weather. A 28-foot salmon troller has proven to be entirely satisfactory for continuous, day after day tagging in good and moderately poor weather. The ideal vessel is a bit larger than this and should have a bait tank mounted on the stern. The Division of Fish and Game has several 45-foot high speed patrol boats which are excellent and which have been made available for tagging through the courtesy of the Bureau of Patrol. When there is a great deal of tagging to be done, one of these boats can be equipped with a bait tank and a $1\frac{1}{2}$-inch circulating pump. The tank is $6 \times 2\frac{1}{2} \times 2\frac{1}{2}$ feet and can accommodate over 200 average sized live mackerel.

In Mexican waters only one boat has been used to date for tagging or any other research. That is the 86-foot patrol and research boat *Bluefin*. This boat has also been used locally.

#### Catching the Fish

When a tagging trip is under way the first problem is to find fish. In California waters this is usually quite simple. Although the fish tend to concentrate in quite limited areas, there are a great many mackerel fishermen in California and between them they manage to keep quite close track of the fish. Often the position of the schools is known

so exactly that there is nothing to do but go there and drop anchor. In Lower California it is a different story. No one fishes for mackerel, no one ever has more than the vaguest idea where they are, and often it is a weary, day after day search with no results. Our trips in Lower

FIG. 3. Dip netting mackerel. The fish are lured close to the boat by chumming with ground-up fish. Quite often mackerel can be gotten clear up to the surface and into such a frenzy of excitement that they are oblivious of everything except the free meal. At such times, they are easy prey for the man with the large wire-meshed dip net. This picture was taken on a commercial boat, but the tagging crews use the same method. At Monterey the dip netting method is not used—the mackerel seldom if ever crowd together near enough to the surface. Photograph by Richard S. Croker.

California are not out and out tagging trips; there is a great deal of other research work to be done and usually the crew simply goes ahead with this other work while keeping an eye out for taggable fish.

Once fish have been found some one starts "chumming" the mackerel by throwing ground-up fish overboard. If the fish are interested they gather around and start feeding. Often mackered are found by chumming blind in some likely spot where none are seen. For several minutes the ground-up chum may settle and drift away, into a seemingly empty ocean. Suddenly, a fish flashes into view, then another, then the water is full of them. Whereupon the crew starts fishing.

Often the mackerel rush for the chum in a seething boiling mass, and the prospects of a real catch look excellent. When this happens, the crew puts overboard a floating impounding net about 12 feet across and four feet deep. Often, however, the prospects do not look any too

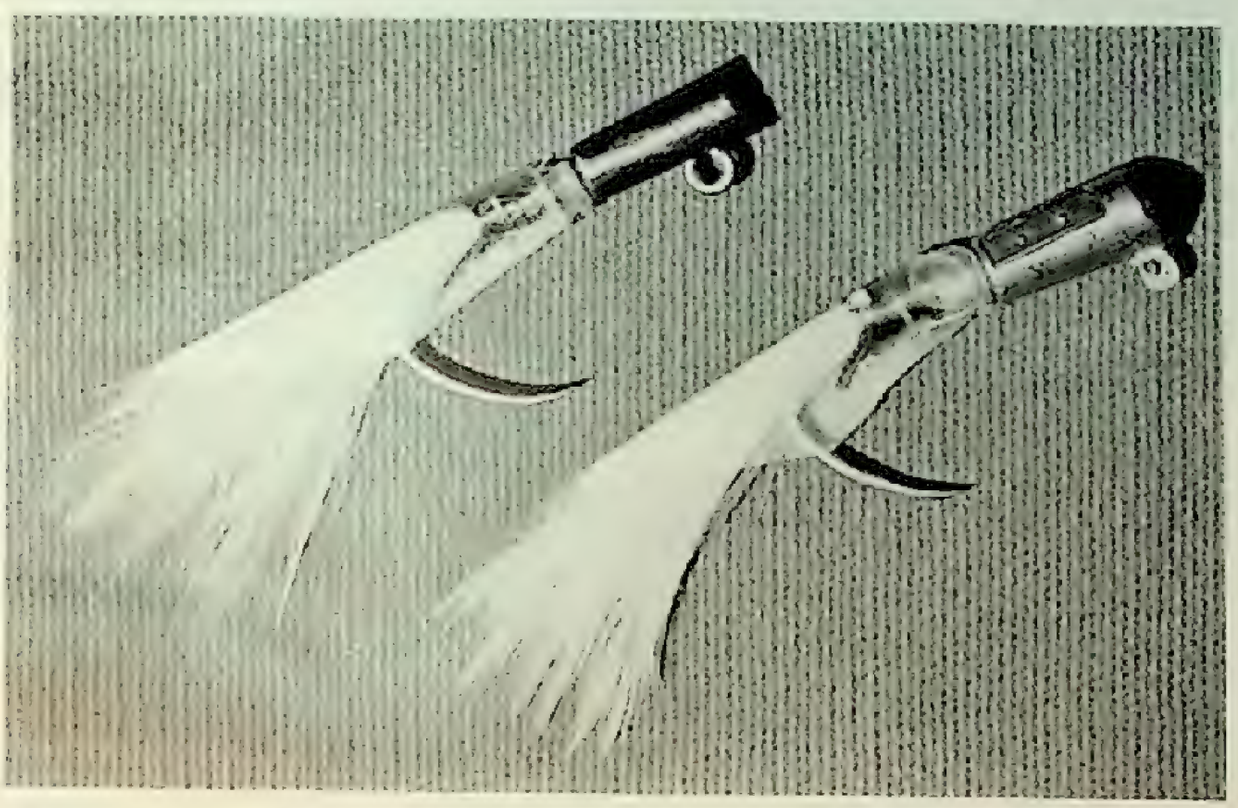

FIG. 4. Mackerel strikers, actual size. These strikers are skittered around near the surface, a mackerel strikes, the fisherman flips him out and slackens the line. Usually the fish shakes the hook out while in mid-air or within a second or two after landing.

Occasionally, when the fish will not come to the surface, strikers can be used effectively by letting them down several feet, twitching them slightly or moving them slowly. This is by no means as effective as surface fishing, but is often far faster than using a hand line. Photograph by D. H. Fry, Jr.

good and it seems probable that it will soon be necessary to move. In such cases the few fish which are caught go into the bait tank. On boats which have no bait tank it is necessary to use the impounding net even when prospects are not so high, unless fishing is so very poor that it is practical to tag the fish as they are caught.

The gear used for catching mackerel is quite diverse. If enough ground-up chum is used the fish can sometimes be gotten into a ravenous, reckless mass, oblivious of everything except the free meal they are getting. When this happens the best gear is a long-handled dip net about two feet in diameter and made of chicken wire. This is lowered into the water, a handful of chum is thrown just in front of it, and

when the stampede is at its height the netman heaves and any number up to twenty or thirty surprised fish find themselves in the impounding net. One of these dip nets is shown in action in figure 3. The man using it is a commercial fisherman, hence the fish are going onto the boat not into an impounding net. If the fish are ravenous, but retain enough sanity to make use of the dip net impractical, the best gear is a bamboo pole, a short line with a heavy wire leader, and a feather "striker." The striker (see Fig. 4) vaguely resembles a giant, heavily weighted trout fly with a barbless hook. It is skittered around on or near the surface. A mackerel strikes, the fisherman flips him toward the impounding net and slackens the line. Usually the fish will spit the hook out in mid-air or within a second or two after landing. If the fish are not too interested in the striker some men prefer to bait a featherless striker hook. This has the advantage that the fish can spit the hook out without any help from the fisherman, but has the disadvantage that the bulky hook is so conspicuous that cautious fish will pass it up. Hence, when the fish are looking first instead of just grabbing, the fishermen use a gut leader and an ordinary hook with the barb flattened. Even when such a hook is bent to the same shape as a striker hook the fish do not shake it out as readily—the hook has not the weight to make this easy so the fish must be carefully unhooked by hand.

Often the fish can not be lured near enough to the surface to make pole fishing practical. In such cases, hand lines are used. In the Monterey region it is usually necessary to hand-line all of the fish. In southern California fishing is enough better so that it is usually possible to use dip nets or strikers.

When fishing gets too slow or the impounding net becomes crowded, part of the crew stops fishing and starts the actual tagging operations. Preferably at least one man continues to chum and fish, and if the mackerel suddenly start to bite again everyone can fish till the spurt is over. Occasionally fishing is good enough so that it is possible for one or two men to catch fish faster than four men can tag them. When this happens everyone fishes till the impounding net and bait tank have nearly the optimum loads, then the taggers get to work and the fishermen keep tank and net well filled.

**Tagging** (See Figs. 5, 6 and 7.)

Tagging operations can be carried out efficiently by crews of two, three or four men. When four men are used the work is divided as follows: One man dips a fish out of the net and holds it in front of the measurer who lifts it out of the dip net onto the measuring board, calls out the length and lifts the edge of one gill cover. The tagger, using a special pair of pliers, slips the tag into position, clinches it shut, and then removes and reloads his pliers while the measurer is getting that fish overboard and getting the next one measured. A fourth man keeps the records, noting the length of each fish after the corresponding tag number. In a three-man team one man dips the fish and keeps the records. This is perfectly satisfactory as long as there are plenty of fish in the bait tank or impounding net. Under these conditions a man can dip out the fish without wasting any motions and without paying any real attention to anything but the records. When the supply of

mackerel gets low the fish are better able to avoid the dip net and a man has to put mind and muscle to work to catch them, and if he is recording as well he is bound to keep the rest of the crew waiting. A two-man team works better than might be expected. The tagger has dry hands, and hence records as well. The other man dips and measures.

When using internal tags there are two different systems of operation. One method, used for large fish, is much the same as that used for external tags. The only difference is in the work of the tagger. This man uses a scalpel to make a tiny slit in the side of the fish, inserts the tag part way with his fingers, then pushes it clear into the body

FIG. 5. Measuring a mackerel before tagging. The measuring board is on top of the bait tank. The supply of fish is in the tank; the dip net is used to catch them and lift them out. Photograph by D. H. Fry, Jr., October, 1938.

cavity with a pair of forceps and gives it a quarter turn so it will not slide back out through the slit.

The other process is faster, but can be used satisfactorily only on rather small mackerel. It is the system evolved for sardine tagging. One man puts the fish on the measuring board, holds its head down with one hand and makes the necessary scalpel incision with the other. His companion meanwhile holds the fish's tail down, calls out the measurement, and as soon as the incision has been made slips the tag into the opening with his fingers and pushes it clear in with the forceps. This last method sounds complicated, but actually it goes like clock-

work if sardines or quite small mackerel are being handled. Large mackerel are too active and powerful to be held down properly by two men, each using one hand. One man devoting two hands and his entire attention to the task can do far better. Unlike some other fish, mackerel do not lie quietly and allow the routine to go along smoothly. They

FIG. 6. Clamping a tag in place on a mackerel's gill cover with the special tagging pliers. Photograph by D. H. Fry, Jr.

FIG. 7. Tag in place on gill cover.

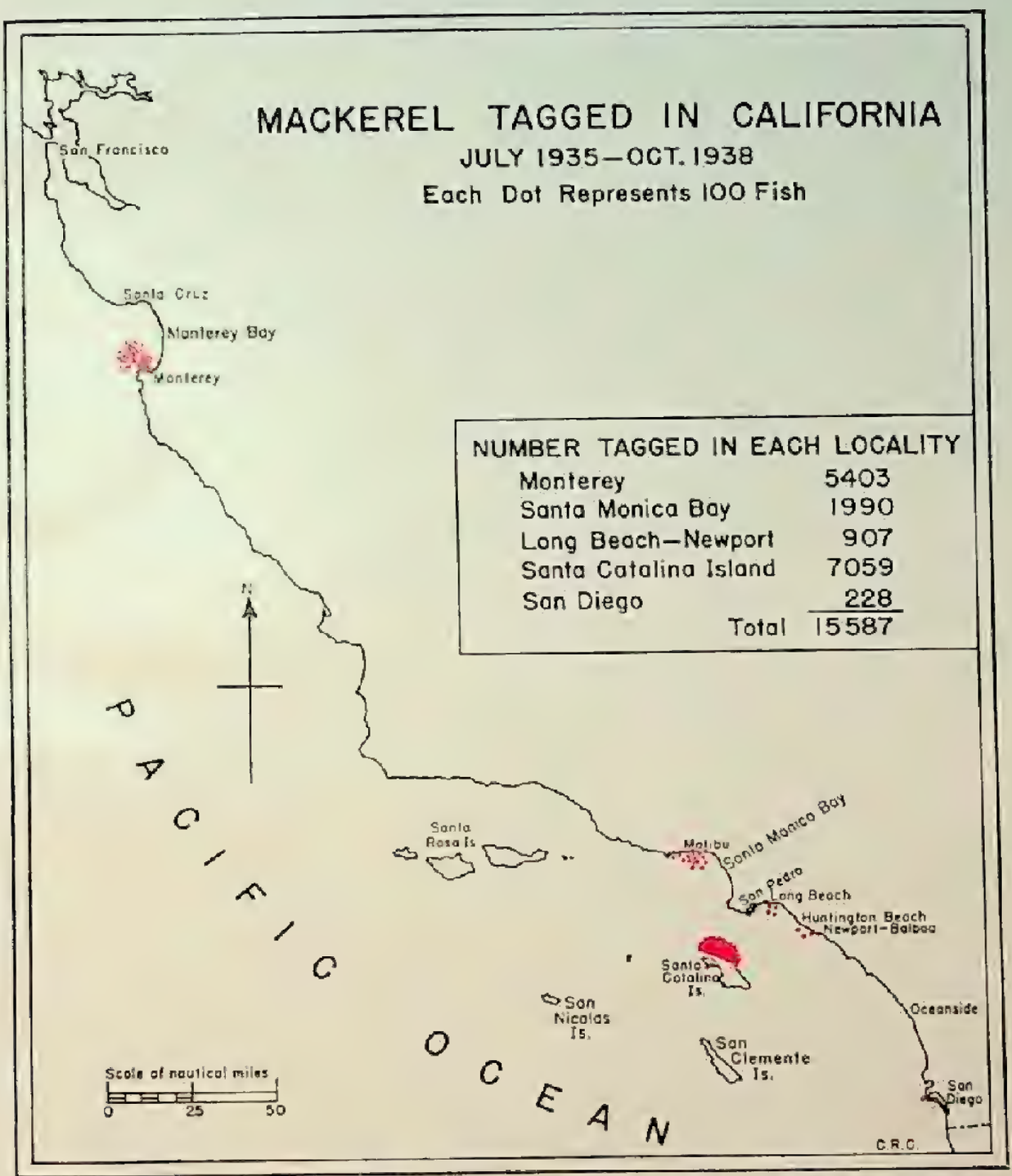


FIG. 8. Map showing where fish have been tagged in California waters. Each dot represents 100 tagged fish. The tagging at Monterey and at Catalina Island was concentrated in a far smaller area than it was possible to show on a map of such small scale.

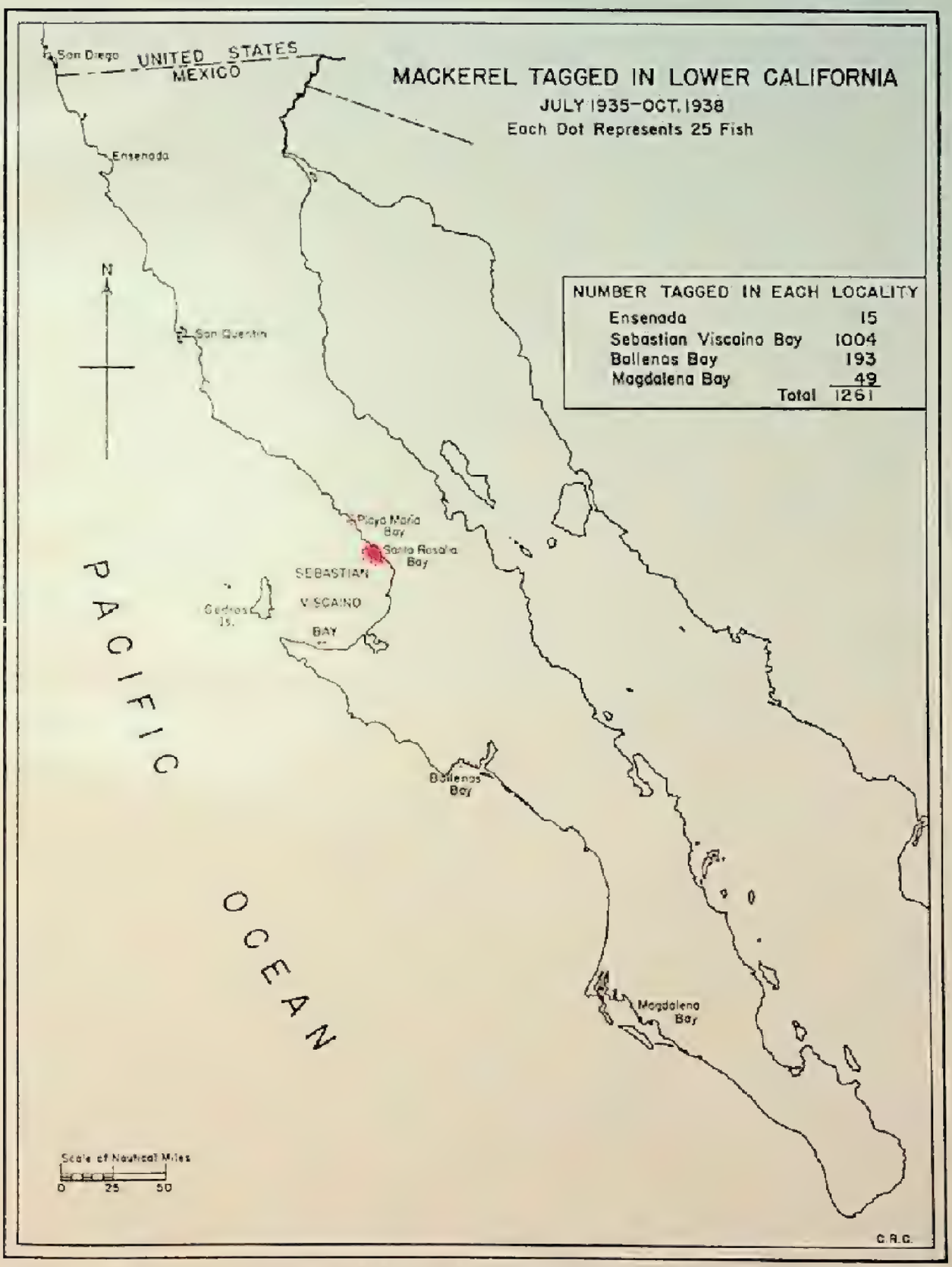


FIG. 9. Map showing where mackerel have been tagged in Lower California waters. Each dot represents twenty-five tagged fish.

take every advantage of their strength, speed, spines and slipperyness, and regardless of what system the taggers are using, they lose quite a bit of time recovering fumbles.

### Location of Tagging Operations

At the end of October, 1938, a total of 16,848 mackerel had been tagged. Of these, 5403 were tagged at Monterey, 10,184 in southern California, and 1261 in Lower California. Figures 8 and 9 show the places in California and Lower California where mackerel have been tagged.

Far better distribution of tagged fish was planned on paper, but circumstances caused a modification of plans. We had intended to tag many more in Lower California in 1937 and 1938. Instead we had long and fruitless hunts for fish, and the few schools we did find would not stay around the boat. Apparently they had no interest whatever in the chum we offered them. Tagging planned for southern California during the winter of 1937-38 was to be divided among several localities. We fished in several places and were getting anywhere from nothing to 75 mackerel per day. Then we tried Catalina Island and were able to average over 450 per day. Needless to say the bulk of the tagging was done at Catalina Island. By way of contrast, the tagging at Monterey has been carried on exactly as planned. As the tagging project is continued it is planned to fill in the gaps as well as possible.

### Recoveries

At the end of October, 1938, there had been 412 fish recovered out of the 16,848 tagged. These returns can be divided into several groups as follows:

1. Recoveries made within 10 miles of the place of release: This group includes 233 of our 412 recoveries. Figure 10 shows the distribution of such returns in southern California. At Monterey there were only five such recoveries; all these fish were tagged and recovered within three miles of Monterey Harbor, hence there is no need for a map.

2. Fish tagged and recovered in the same general region but the exact locality of recovery not known: These are fish from which tags were taken on cannery magnets. The group includes 115 fish recovered in the San Pedro region and 15 at Monterey.

3. Fish which show a definite movement: The movements of such fish are shown by the arrows in figures 11 and 12. Two maps are used to reduce the confusion of too many arrows running in many different directions. Figure 11 includes 23 recoveries which were made by cannery magnets. Frequently it is possible to determine with reasonable certainty where such fish were taken. The fishing fleets often operate in a rather limited area for several weeks, and it is reasonably safe to assume that tags taken during that period were taken in that area. The areas of recovery of 19 of the 23 such tags shown on figure 11 were determined by this method. This data is in the caption, not in the figure itself. We can not be absolutely certain of such results because once in a while a tag will hang up in the cannery machinery for some weeks, and there is always a chance that a boat caught fish some dis-

TABLE 1

Number of Mackerel Tagged in Each Locality from the Inception of the Program to November 1, 1938

| Type of tag | 1935 (July to December) | | | 1936 | | | 1937 | | | 1938 (To November 1) | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | External | Internal | Total | External | Internal | Total | External | Internal | Total | External | Internal | Total | External | Internal | Total |
| Monterey Region | 538 | | 538 | 199 | | 199 | 2,344 | 2,322 | 4,666 | | | | 3,081 | 2,322 | 5,403 |
| Southern California— | | | | | | | | | | | | | | | |
| Santa Monica Bay | 8 | | 8 | 1,133 | 212 | 1,345 | | 3 | 3 | 483 | 151 | 634 | 1,624 | 366 | 1,990 |
| Long Beach | | | | 551 | | 551 | | | | | 2 | 2 | 551 | 2 | 553 |
| Newport-Balboa | 4 | | 4 | | | | 84 | 10 | 94 | 5 | 251 | 256 | 93 | 261 | 354 |
| Santa Catalina Island | | | | | | | 1,017 | 1,274 | 2,291 | 1,765 | 3,003 | 4,768 | 2,782 | 4,277 | 7,059 |
| San Diego | 203 | | 203 | 24 | | 24 | | 1 | 1 | | | | 227 | 1 | 228 |
| Lower California | 194 | | 194 | 1,005 | | 1,005 | | 15 | 15 | 20 | 27 | 47 | 1,219 | 42 | 1,261 |
| Totals | 947 | | 947 | 2,912 | 212 | 3,124 | 3,445 | 3,625 | 7,070 | 2,273 | 3,434 | 5,707 | 9,577 | 7,271 | 16,848 |

TABLE 2

Recoveries of Tagged Mackerel by Locality. This Table Includes All Recoveries Through October, 1938. Major Movements Are Indicated by Bold-face Type.

| Fish tagged | | Number recovered to November 1, 1938 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northern California | | | | Southern California | | | | | | | | | |
| Locality of release | Number released to November 1, 1938 | San Francisco canneries | Santa Cruz | Monterey | Monterey canneries | Santa Monica Bay | San Pedro-Long Beach canneries | Long Beach | Huntington Beach-Newport | Santa Barbara Island | Santa Catalina Island | San Clemente (town)-Oceanside | San Diego | Lower California | Total |
| Monterey | 5,403 | 3 | 1 | 5 | 15 | 3 | 17 | | | | | | | | 44 |
| Santa Monica Bay | 1,990 | | | | | 66 | 6 | 1 | 2 | | | | | | 75 |
| Long Beach | 553 | | | | | 3 | 4 | 142 | | | | | | | 149 |
| Newport-Balboa | 354 | | | | | 1 | 3 | | 1 | 1 | | | 1 | | 7 |
| Santa Catalina Island | 7,059 | | | | 1 | | 102 | | 3 | | 23 | 3 | 2 | | 134 |
| San Diego | 228 | | | | | | | | 2 | | | 1 | | | 3 |
| Lower California | 1,261 | | | | | | | | | | | | | | |
| Totals | 16,848 | 3 | 1 | 5 | 16 | 73 | 132 | 143 | 8 | 1 | 23 | 4 | 3 | | 412 |

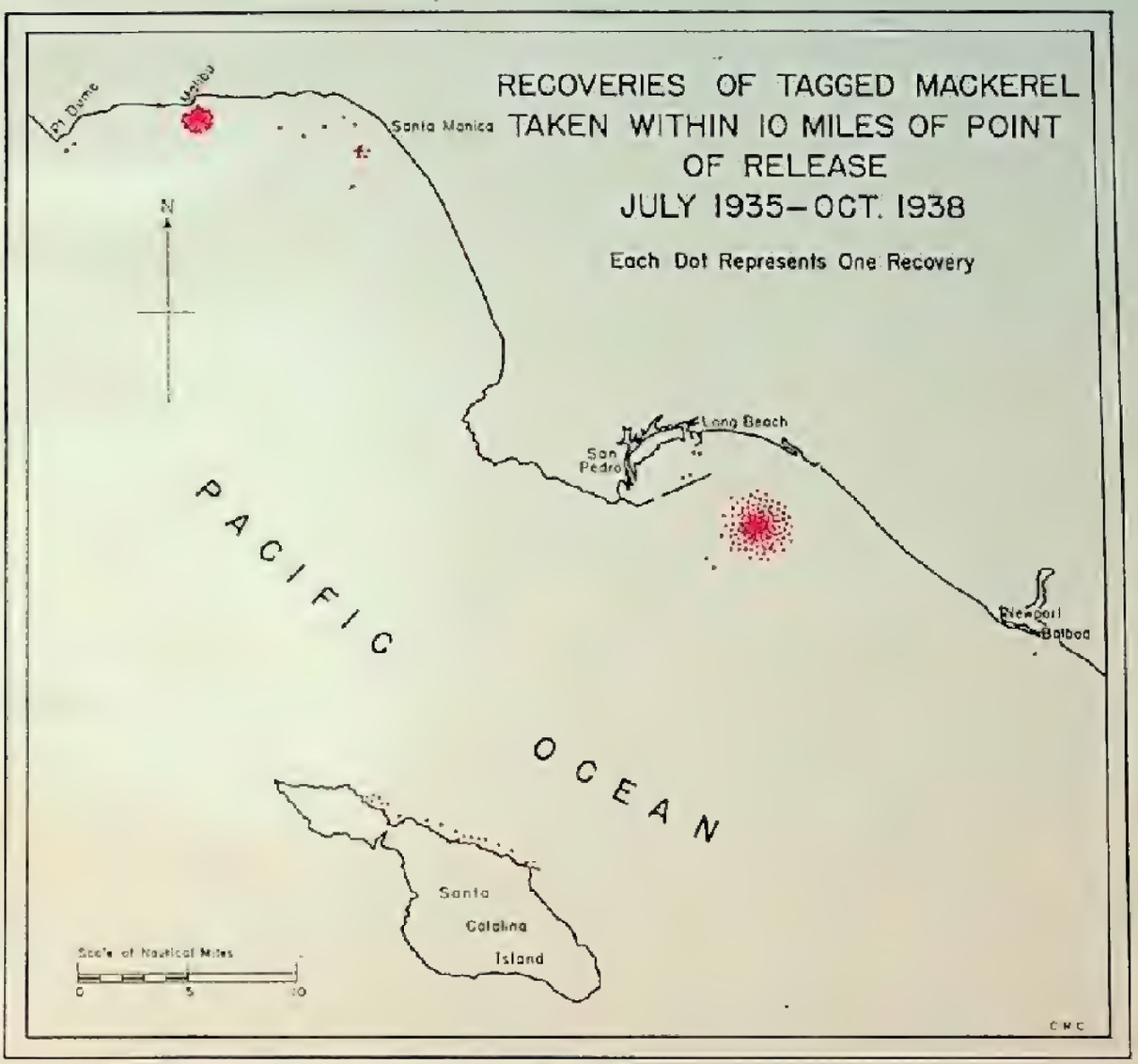


FIG. 10. Recoveries of tagged mackerel. Each dot represents the point of recovery of one mackerel, retaken within ten miles of the point of release. The recoveries at Malibu were made in a far smaller area than it is possible to show on this scale of map. The constellation of recoveries at Long Beach is approximate in position but is only estimated in spread. The spread shown is the maximum that is at all probable.

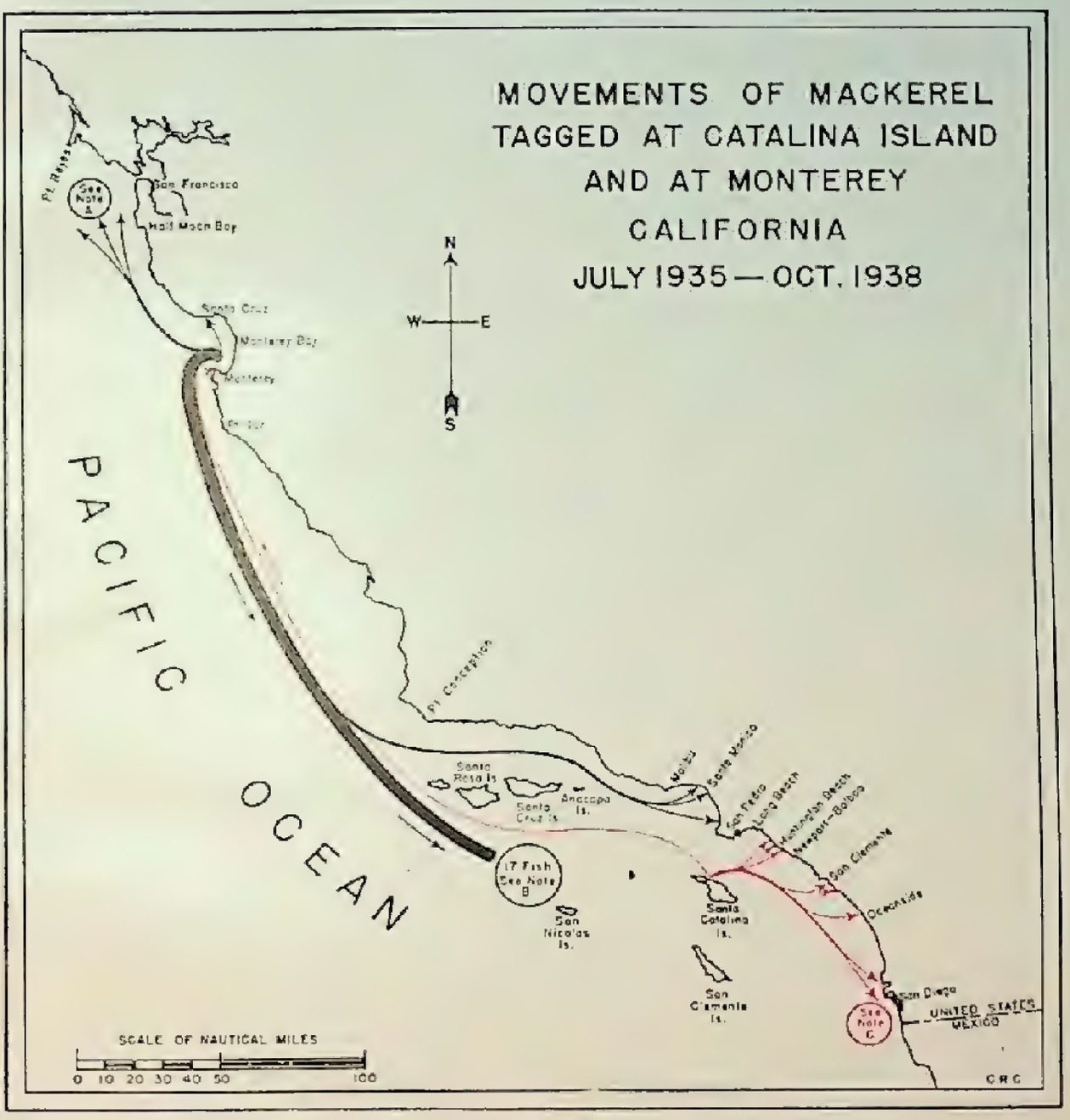


FIG. 11. Movements of mackerel tagged at Catalina Island and at Monterey, California.

*Note A:* These three tags were recovered by magnets in the San Francisco sardine reduction plants. Judging from the movements of the fishing fleet, two of these fish were almost certainly taken north of Half Moon Bay. The third may have been caught as far south as Monterey Bay, but it too was probably taken north of Half Moon Bay.

*Note B:* These seventeen tags were recovered by cannery magnets in the San Pedro region. It appears reasonably certain that twelve of these were taken in the area which includes Santa Cruz and Anacapa Islands and the nearby mainland. One, fairly definitely, came from south of San Pedro. The other four could have been taken almost anywhere in the fishing area covered by San Pedro boats.

*Note C:* These two tags were recovered by San Diego cannery magnets. The fish were taken within twenty-five miles of San Diego.

The one recovery shown at Monterey was from a magnet. The fish was probably caught in Monterey Bay, but possibly was as far north as Half Moon Bay.

tance from the place where the fleet was operating and neglected to report where the catch was made. In any event the operations of the boats at each port are confined to a rather well-defined area, and we can say that tags recovered were taken within that area. It is necessary to take into account the area covered by sardine boats as well as mackerel boats because a few mackerel often mingle with the sardines and are caught with them.

The areas covered by sardine and mackerel boats operating out of the various ports are as follows:

*San Francisco.* There are no mackerel boats here. Sardine boats fish from Monterey Bay to about 40 miles north of Point Reyes.

*Monterey.* Mackerel boats stay within 10 miles of port. Sardine boats fish from Point Sur to Point Reyes.

*San Pedro.* The same boats cover the same territory for both species. The range is from a little south of Oceanside to Santa Rosa Island and the adjacent mainland, and off-shore a bit beyond San Clemente and San Nicolas Islands.

*San Diego.* Sardine and mackerel boats stay within 25 miles of port.

### Mackerel Movements

The tagging done to date has definitely shown that there is an interchange of fish between southern California and the Monterey region. (See Fig. 11.) Twenty of the fish tagged at Monterey were recovered in southern California, and one fish has been taken after making the trip in the other direction. This must not be taken to indicate that there is a heavy southward movement and a light northward one. In southern California the mackerel catch is far more than twenty times as great as it is at Monterey. Some idea of the intensity of the southern California fishery can be gained from the fact that of all the fish tagged at Monterey as many have been recovered in southern California as at Monterey.

In southern California we have enough data to show that there is a mingling of fish from all parts of this area.

The lack of returns from Lower California shows exactly nothing. Unpolished external tags were used on nearly all the fish tagged in this region. As mentioned, these tags do not stay in place at all well and if any of the fish did get north of the international line they had probably lost their tags before doing so. The only mackerel fishing carried on in Lower California is near Ensenada, 50 miles below the border, so it is only near Ensenada that we may expect any Mexican recoveries. Except for 15 fish tagged during a slight delay at Ensenada, all Lower California tagging has been done more than 200 miles farther south.

Eventually our tagging operations should enable us to make far more extensive statements about the movements of mackerel, especially as regards seasonal movements, but at present the data are too scattered to make it safe to draw further conclusions.

### Time Between Tagging and Recovery

The time between tagging and recovery of tagged mackerel is shown in figure 13. After the fish have been through the rather harrowing experience, there is usually a lag of some days before their appetite increases and their wariness decreases to the point where they are getting into trouble again. Then often follows a period of several weeks during which many fish are taken very close to the point of release.


FIG. 13. Time interval between tagging and recovery of all fish recovered prior to November 1, 1938. Two fish recovered in November, 1938, were out approximately two years each (103 and 105 weeks).

Then the fish appear to move away from that spot—sometimes quite suddenly, sometimes gradually. From that time on the recoveries are much more gradual and are usually from more distant places.

The peak in the number of returns is heightened by heavy fishing in the vicinity where the tagging is done. We tag where we can catch mackerel in numbers—and it is in such spots that commercial and sport fishermen congregate. In at least two places there were fishermen who were not just fishing for mackerel—they were definitely after tagged mackerel. These spots (Malibu and Long Beach) can easily be found on the map. (See Fig. 10.) At Malibu there were many pleasure fishermen who had a grand time making the day's expenses by catching tagged mackerel. At Long Beach, the fish we had tagged were discovered by a man who is probably the best small boat commercial fisherman in southern California. The extra margin of profit, due to the tag rewards, was enough to keep him going to the same limited area, day after day. This man could doubtless have caught just as much fish in any one of several other places, but in the other places there would not have been a dozen or two tagged mackerel mixed in the catch. Only

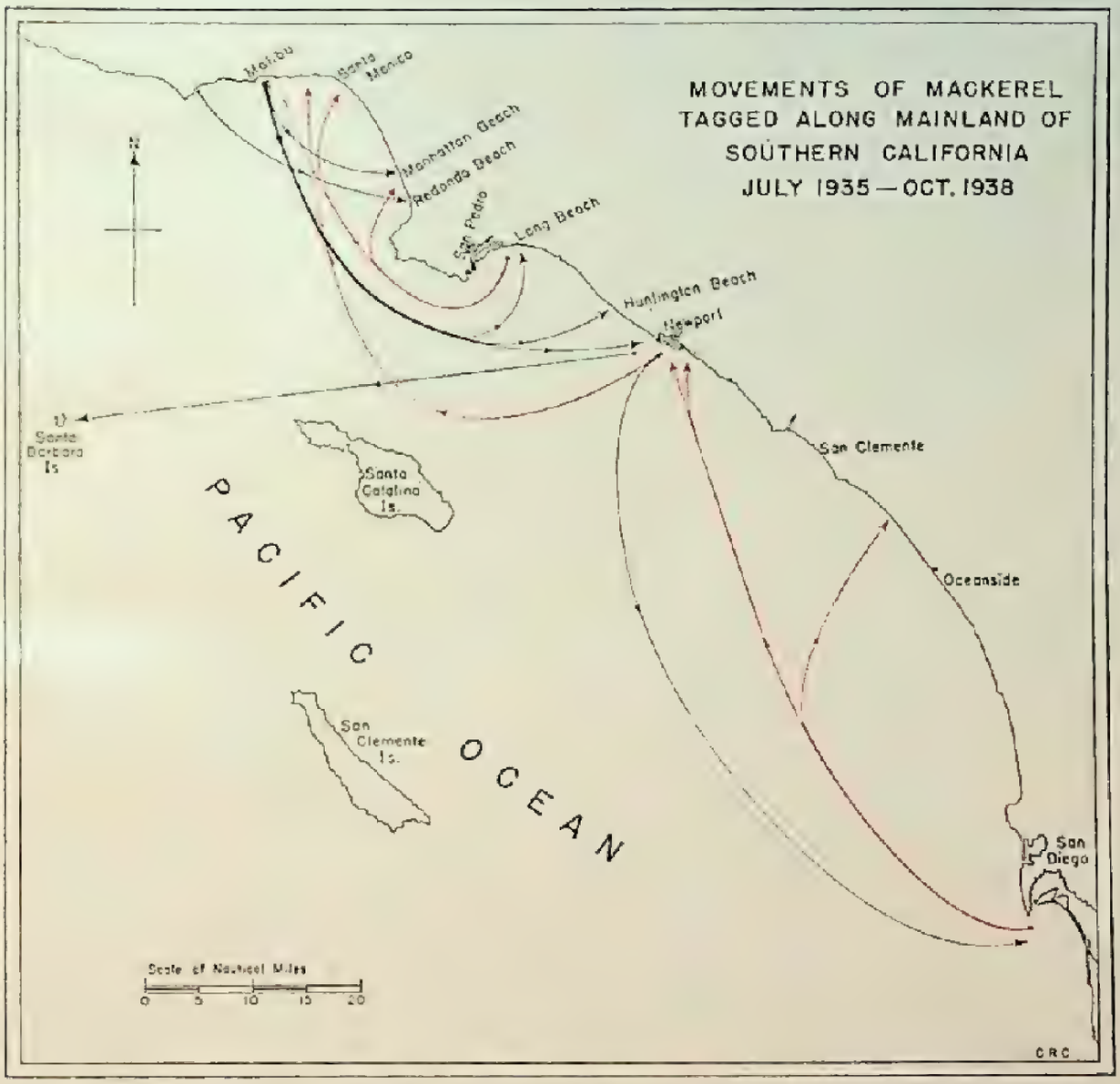


FIG. 12. Movements of mackerel tagged along the mainland of southern California.

551 fish had been tagged, but of this group he and his small crew seined 135 with tags in place and many more which had recently lost their tags, and which were easily identified by torn gill covers. These recoveries were expensive (75 cents each) but were well worth it. It was this batch of fish that showed us that the unpolished tags would not stay in place.

### Maximum Rate of Movement of Tagged Fish

We do not have enough data to enable us to make any estimates on the average speed of mackerel which are moving from one district to another. However, readers may be interested in a note on three of the highest speeds that we have observed:

| | Miles traveled | Days | Miles per day |
|---|---|---|---|
| Long Beach to Manhattan Beach | 21 | under 1 (about 20 hrs.) | about 25 |
| Howlands Landing, Catalina Island, to east end of Catalina Island | 16 | 1 | 16 |
| Monterey to vicinity of Santa Cruz Island. (This was a magnet recovery—fishing fleet was operating in the Santa Cruz Island area.) | about 200 | 34 | about 6 |


FIG. 14. Time interval between tagging and recovery, a comparison between fish which were retaken near the point of release and those which showed a movement of over ten miles. There are many magnet recoveries which are not included here—we could not be sure whether or not the fish was caught more than ten miles from the point of release.

## Summary

Since 1928, Pacific mackerel have been taken in large quantities for canning purposes.

Already the fishery is showing signs of serious depletion.

The range of the species is from Vancouver Island to the tip of Lower California (nearly 2000 miles) but the heavy fishing is concentrated between Point Conception, California, and Ensenada, Lower California (260 miles).

It is important to know if the heavily fished southern California population is isolated or if fish move into it from other areas.

There is heavier spawning in Lower California than in California. It is important to learn if this means that the Mexican population is larger, or if California fish migrate south to spawn.

To answer these questions and others, a tagging program was launched in July, 1935.

Rewards are offered for return of tag or tagged fish (50 cents for tag alone, 75 cents for tagged fish).

Two types of tags are used: (1) A strap tag of nickel which is clamped onto the gill cover. (2) An internal tag of nickel-plated steel. Both types are recovered by magnets installed in the cannery reduction plants. The gill cover tags are also recovered by fishermen.

When purchased, the gill cover tags were all quite rough on the edges, irritated the fish and would not stay in place. Polishing the tags remedied all this.

Boats used for tagging have been of many types and from 16 to 86 feet long. Twenty-eight foot and larger boats have proven entirely satisfactory.

To catch the mackerel, dip nets and feather strikers are used when the fish are ravenous enough to come close to the boat, hand lines when they are not.

When caught, the fish are placed in an impounding net or bait tank until it seems advisable to start tagging.

Tagging is done by crews of two, three or four men.

By November 1, 1938, we had tagged 16,848 mackerel; 5403 at Monterey, 10,184 in southern California, and 1261 in Lower California.

Of these fish, 412 have been recovered: 233 were retaken within 10 miles of place of release, 130 were recovered by cannery magnets in the same general area in which they were tagged, and 49 were recovered more than 10 miles from the place of release.

Tagging has shown that there is an interchange of fish between Monterey and southern California and a mingling of fish from different parts of the southern California area.

There have been no returns from Lower California, but this shows nothing since most of the fish were tagged with the unpolished gill cover tags before it was discovered that these would not stay in place.

After being tagged, the fish usually remain in the same area for some weeks and often many are recovered quite close to the point of release.

When the fish move away from the place of release, the rate of recovery drops off.

The elapsed time between tagging and recovery has been as long as two years.

Some of the more rapid rates of movement shown by tagged fish are 21 miles in 20 hours and 200 miles in 34 days.

# THE MARKET CRAB OF CALIFORNIA AND ITS CLOSE RELATIVES [1]

*By* J. B. Phillips
*California State Fisheries Laboratory*
*Division of Fish and Game*

In California, the only species of crab to which protective restrictions apply is the market crab (*Cancer magister*). Related to this crab are several other species that are caught commercially in southern California and noncommercially in northern California. South of Monterey Bay, the market crab decreases rapidly in abundance. In southern California, where only an occasional market crab is caught, small quantities of several crabs collectively referred to as "rock crabs" are caught and sold. These are: the yellow crab (*Cancer anthonyi*), the rock crab (*C. antennarius*), and the red crab (*C. productus*). The latter two species are also common in northern California, but are not caught for sale because of the presence of the larger, meatier and more abundant market crab. Some commercial fishermen and sport fishermen do, however, take "rock crabs" for home consumption. In northern California there is one other related species, the slender crab (*C. gracilis*), small in size, with which the young of the market crab may be confused. It is with the gross descriptions of the related species mentioned above that this article is concerned, the aim being to aid identification by a few readily observed characteristics rather than by detailed scientific descriptions.

These crabs are all of the family Cancridae and the genus *Cancer*, meaning hard shell, and are characterized by a carapace that is broadly oval and saw-toothed on the front side. In all, nine species of this family and genus are found in California, but the other four species, *Cancer jordani, C. oregonensis, C. amphioetus,* and *C. gibbosulus,* are not described here as they are small and comparatively rare. In California, all the crabs of the above family and genus have black-tipped pincers, except the market crab and the slender crab which have white-tipped pincers.

## Molting of Crabs (Undersized Legs)

Molting is general among crustaceans. The hard shell of the crab prevents growth and so at intervals of about one year the entire hard shell of the crab is cast off or molted. Before the actual molt, a new protective covering is started, but this is uncalcified and therefore soft. During the period when the shell is cast off, the crab is known as a "soft" crab and it is during this interval of a few days that the crab undergoes a period of rapid growth before the new shell becomes calcified and fixes the size of the crab until the next molt. At molting time the old shell slits at the junction of the carapace and the abdomen, or

[1] Submitted for publication, September, 1938. All photographs by the author.

tail flap, and the crab, now in the soft shell stage, backs out of the old shell through this slit. It is during the molting period that missing legs are rejuvenated. Following the first molt, after such a mishap, a replaced leg is considerably smaller than the original, but with succeeding molts it attains its normal size.

### Distinction Between Male and Female Crabs

The abdomen, or tail flap, which is folded closely against the underside of the crab, is much broader in the female than in the male crab. This broad tail flap is necessary in the female to accommodate at spawning time the huge numbers of eggs that are attached and receive protection between this flap and the body until hatched. In the adult stage, the comb-like fringe of hair around the edges of the tail flap is quite long in the female but rather short and hardly noticeable in the male. (For examples, compare figures 15 and 16 or figures 18 and 19.) The average size of female *Cancer* crabs is significantly less than that of the male crabs in the adult stage. The female market crab seldom attains a width of seven inches across the back.

### Identification of Cancroid Crabs

The photographs and descriptions given on the following pages should enable the reader to identify the five common species of cancroid crabs.

Anyone who is interested in a more detailed description of these crabs, as well as descriptions of other crabs found in California, is referred to the following publications:

Rathbun, Mary J.

1930. The cancroid crabs of America of the families Euryalidae, Portunidae, Atelecyclidae, Cancridae and Xanthidae. U. S. National Museum. Bulletin, no. 152, 609 pp., illus.

Schmitt, Waldo L.

1921. The marine decapod crustacea of California. California. University. Publications in zoology, vol. 23, 470 pp., 50 pls., 165 figs.

Weymouth, Frank W.

1910. Synopsis of the true crabs (Brachyura) of Monterey Bay, California. Stanford University publications. University series, no. 4, 64 pp., illus.

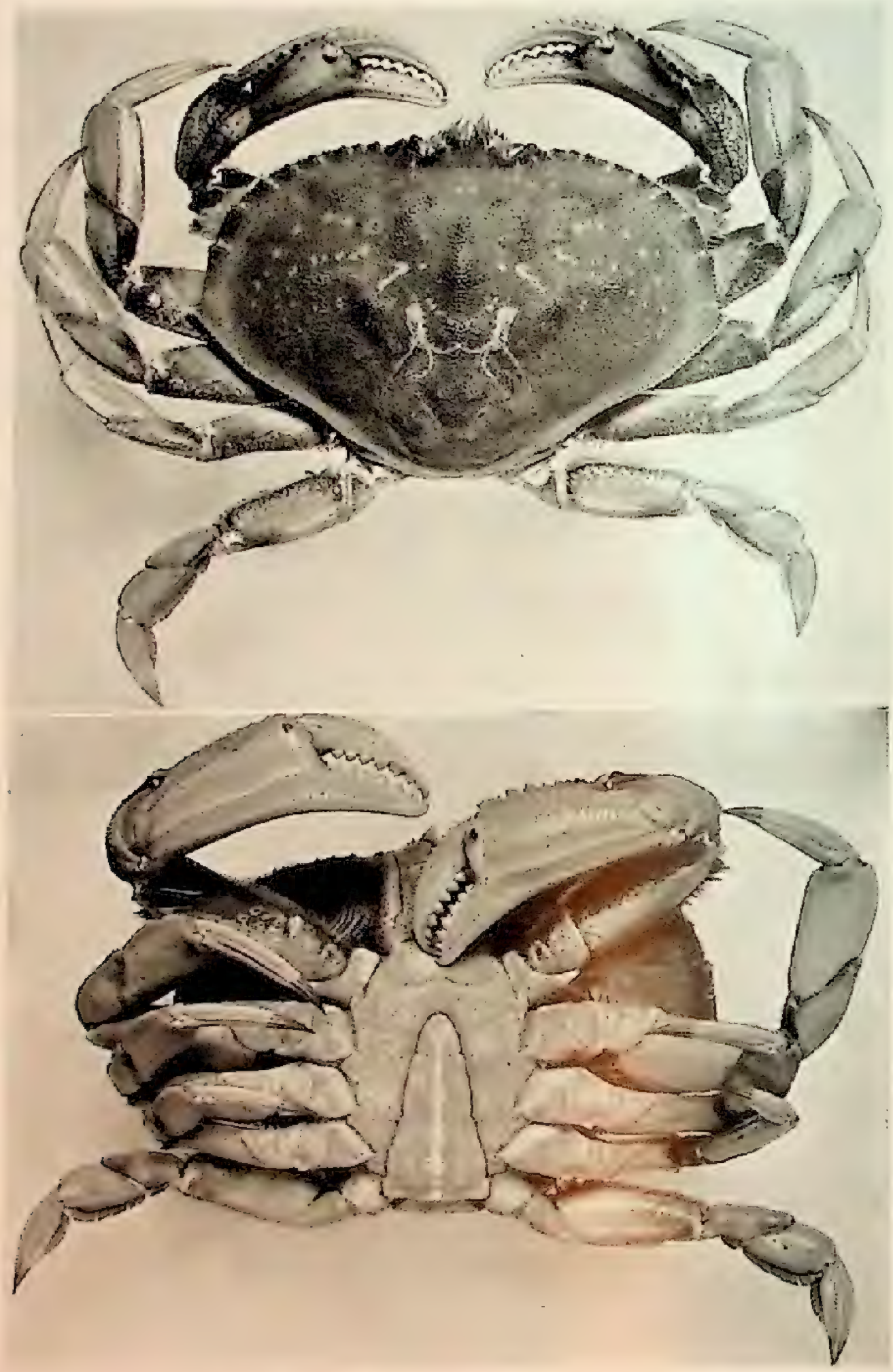

FIG. 15. Market crab (*Cancer magister*). Top and bottom views of a 7-inch male crab.

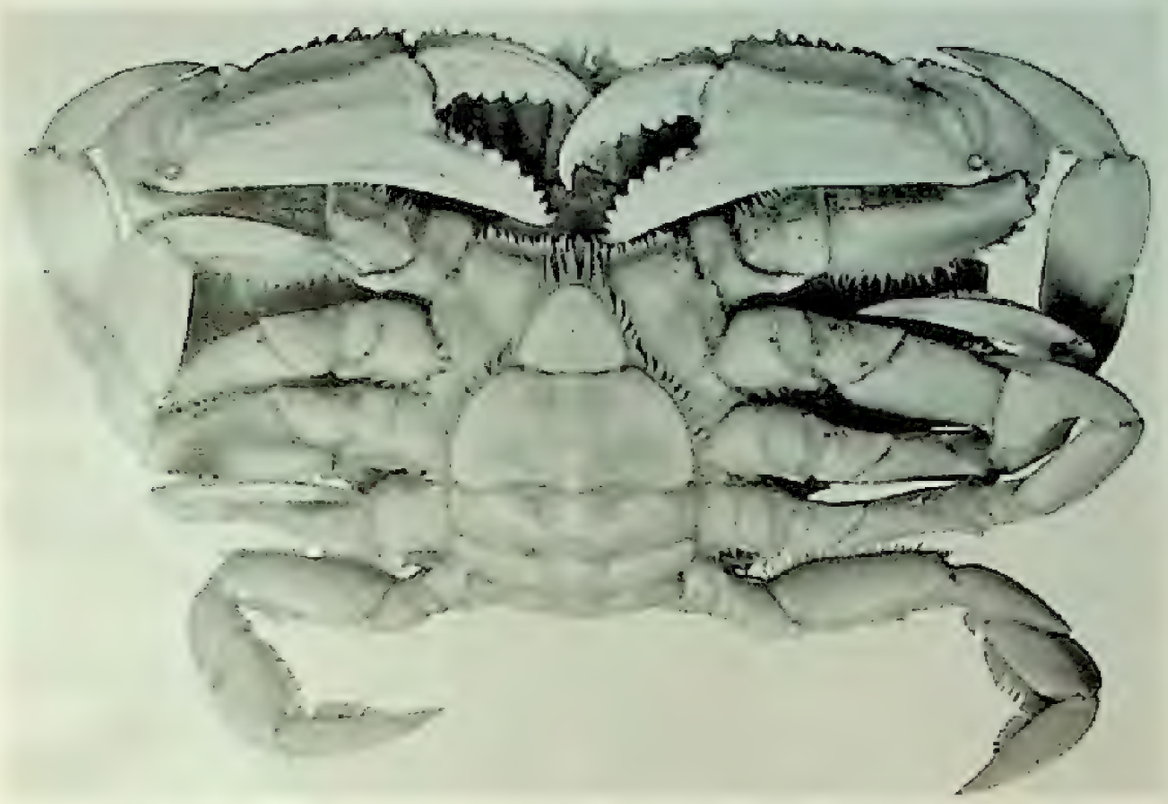

FIG. 16. Market crab (*Cancer magister*). Underside view of a female crab, 6 inches across the back.

## MARKET CRAB

*Cancer magister*

**Distinguishing Characters:** White-tipped pincers on the claws (chelipeds). The top edges of the claws and upper pincers are prominently saw-toothed, there being more than a dozen teeth along each edge. The last three joints of the last pair of walking legs (in particular) have a comb-like fringe of hair on the lower edge, and the joint previous to these has hair on both top and bottom edges, but with a much greater amount on the top edge. (See Fig. 16.) In both male and female, the tip of the last segment of the tail flap is rounded (see photographs) as compared to the pointed last segment of the male and female of all the other crabs herein described. (For examples of this pointedness, see Figs. 18 and 19.)

**Color:** Light reddish brown on the back, with a purplish wash anteriorly in some specimens. The characteristic pattern of lighter streaks and spots on the back is shown in the upper photograph of figure 15. Underside whitish to light orange, the inner and upper sides of the anterior legs with crimson or purple.

**Size:** Attains a width of 9 inches across the back. One of the largest edible crabs along the Pacific Coast of America.

**Distribution:** Unalaska to Magdalena Bay (?), Lower California, but seldom seen south of Santa Barbara.

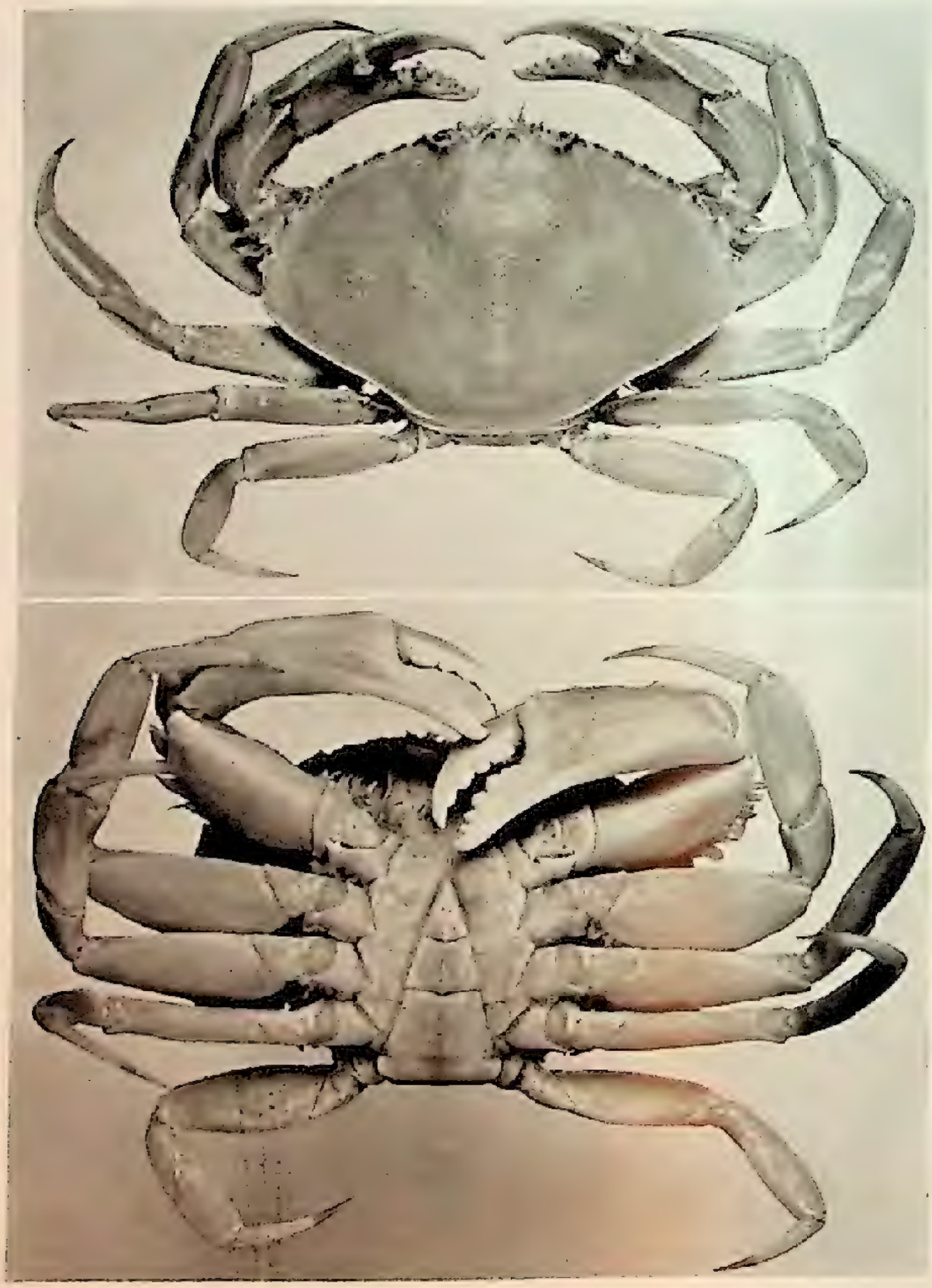

FIG. 17. Slender crab (*Cancer gracilis*). Top and bottom views of a 2½-inch male specimen.

## SLENDER CRAB

*Cancer gracilis*

**Distinguishing Characters:** White-tipped pincers on the claws. The tops of the claws are sharp-edged, with two or three prominent teeth, but these edges are not saw-toothed as in the market crab. The last three joints of all the walking legs are hairless. Compare particularly the last three joints of the last pair of legs with those of the market crab (Figs. 16 and 17), the only other crab of this group which also has white-tipped pincers, and with which this crab may be confused. Since the slender crab seldom exceeds a width of 3 inches across the back, it can only be confused with the young of the market crab. The tip of the last segment of the tail flap is pointed in both male and female. For an example of this pointedness, see figures 17 and 19 and compare with the roundness of this last segment in the market crab as shown in figures 15 and 16.

**Color:** Light olive brown. The coloring on the front sides of the legs may be a yellowish brown to a purple color in darker specimens. The underside is white or yellowish white.

**Size:** Attains a width of 3½ inches across the back.

**Distribution:** Alaska to Sebastian Viscaino Bay, Lower California.

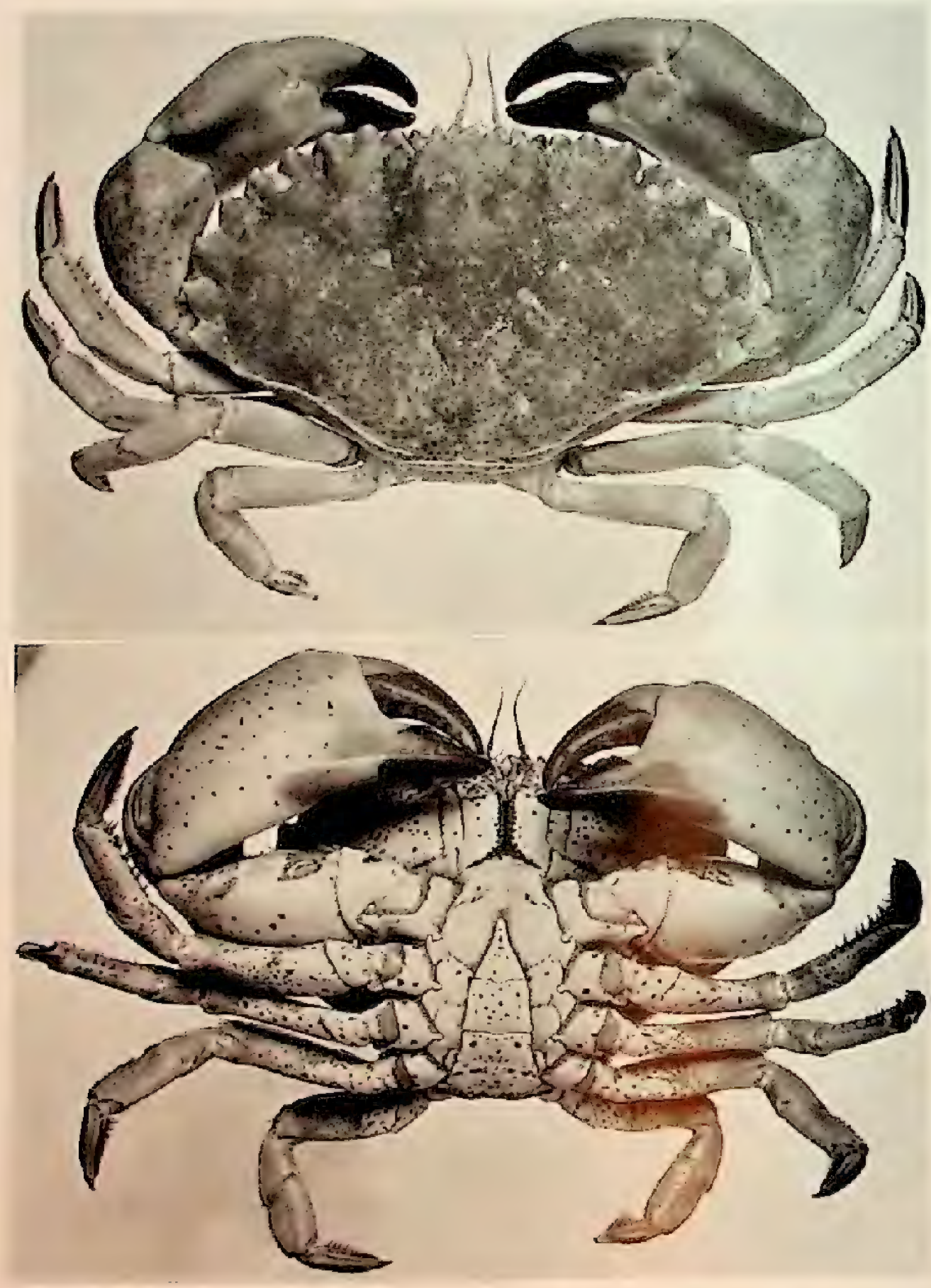

FIG. 18. Rock crab (*Cancer antennarius*). Top and bottom views of a male crab, 5 inches across the back.

## ROCK CRAB

*Cancer antennarius*

**Distinguishing Characters**: Black-tipped pincers on the claws. The hand of the claw is large and smooth. There are a number of small red spots on the underside of the crab (as shown in the photograph) and these are not found on any other crab herein described. In the female, the red spots on the tail flap are usually blocked out by a general red coloration, but the spots can be found on the legs and the underside of the carapace. (The red crab may have red blotching on the underside, but these should not be confused with the distinct spots found in the rock crab.) The tip of the last segment of the tail flap is pointed in both male and female, as for all other crabs described except the market crab. The two antennae are longer in this species than in any of the others described.

**Color**: Medium to dark red-brown, usually mottled with a lighter grayish tinge. Underparts yellowish white, with some red, and the characteristic red spots as noted above.

**Size**: Attains a width of 5 inches across the back.

**Distribution**: British Columbia to Magdalena Bay, Lower California.

**Note**: Occasionally a small female specimen is encountered that is exceedingly hairy on the legs and underparts, and with the long antennae feather-like. This is an extreme variation of this species, and the red spots on the undersurface, together with the other characters as above, will serve to identify it.

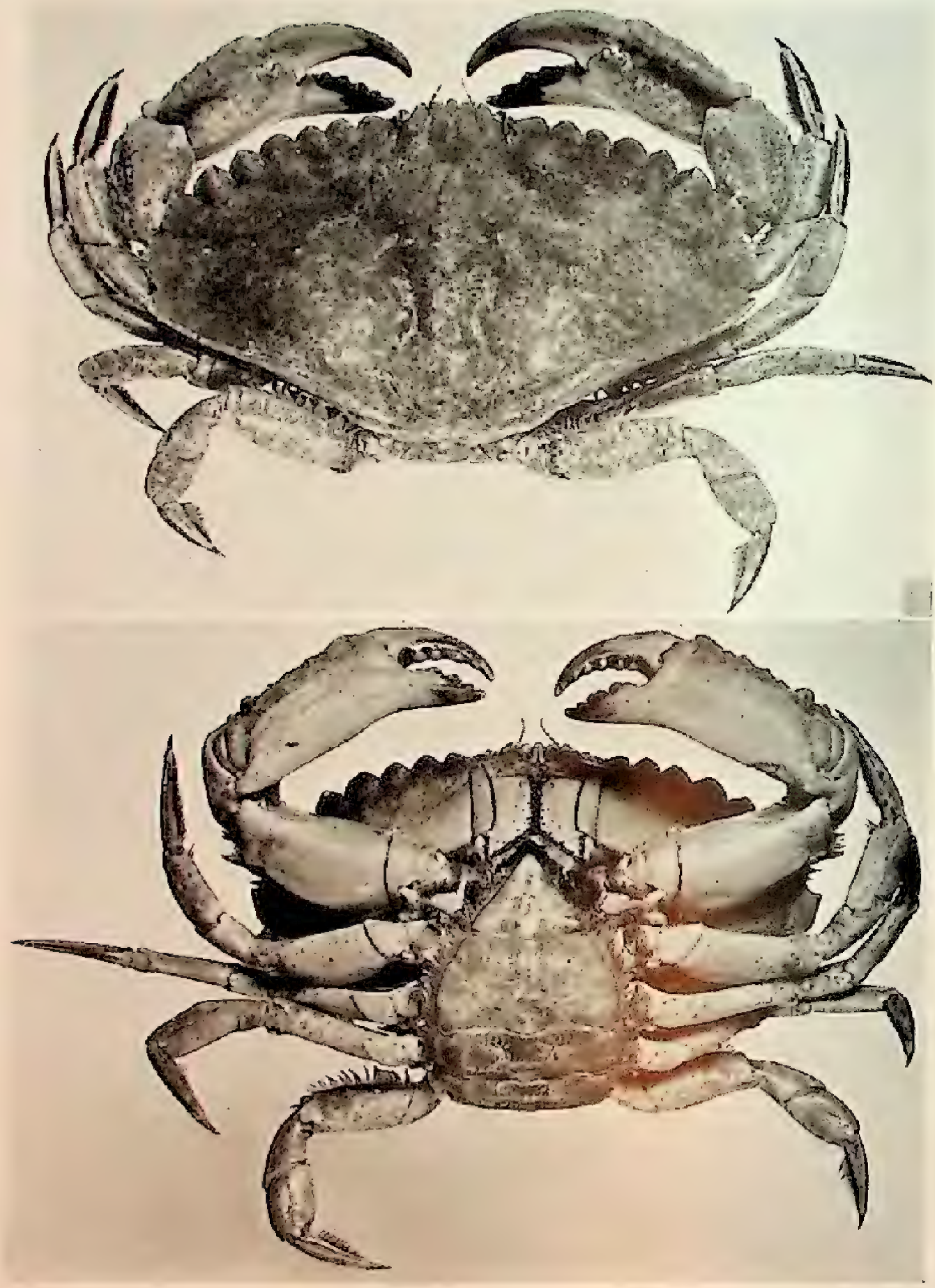

FIG. 19. Red crab (*Cancer productus*). The upper photograph shows the top surface of a 6¾-inch male. The lower photograph shows the under surface of a 5¾-inch female crab.

## RED CRAB

*Cancer productus*

**Distinguishing Characters:** Black-tipped pincers on the claws. The hands of the claws are noticeably roughened, particularly above, but not distinctly saw-toothed as in the market crab. The five teeth between the eyes on the front edge of the carapace are of nearly equal size and project a little forward of the eyes. The tip of the last segment of the tail flap is pointed in both male and female, as for all other crabs described except the market crab.

**Color:** Dark red above, but some specimens are medium red. The underside is yellowish white with orange red blotchings. The tail flap in the female has a great deal of red, as does the tail flap of the female rock crab. The red blotchings on the underside of the red crab are not to be confused with the distinct red spots found on the underside of the rock crab.

**Size:** Attains a width of 7 inches across the back.

**Distribution:** Alaska to Magdalena Bay, Lower California.

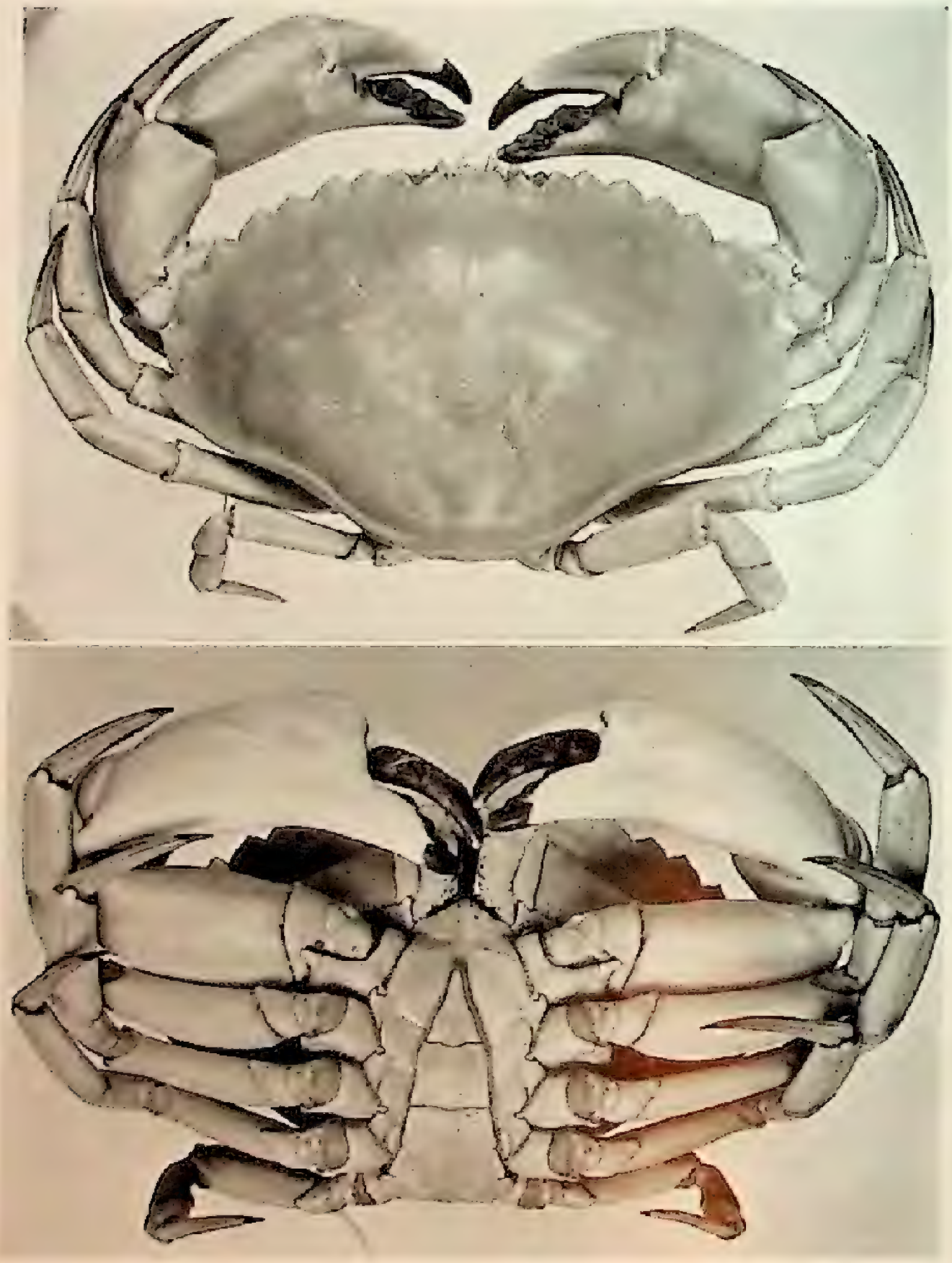

FIG. 20. Yellow crab (*Cancer anthonyi*). Top and bottom views of a male crab, 6 inches across the back.

## YELLOW CRAB

*Cancer anthonyi*

**Distinguishing Characters:** Black-tipped pincers on the claws. The hands of the claws are large and quite smooth, resembling the rock crab in this respect. In fact, all of the legs of the yellow crab are quite smooth. The last five joints of the walking legs lack hair except for very short bristles on the end joints. These bristles may become indistinguishable to the unaided eye, on the last pair of legs. The tip of the last segment of the tail flap is pointed in both male and female, as for all other crabs described except the market crab.

**Color:** Yellow-brown, with a purple wash anteriorly and on the legs in some specimens. Underparts plain yellow or yellowish white.

**Size:** Attains a width of 6 inches across the back.

**Distribution:** Monterey Bay to Magdalena Bay, Lower California, but uncommon north of San Pedro.

5—65935

# SOME OPINIONS OF EARLY CALIFORNIA QUAIL HUNTERS [1]

*By* Howard Twining
*Museum of Vertebrate Zoology*
*University of California*

Mention the name "market hunter" to the present day sportsman and the probable result will be a gnashing of teeth and a flow of invectives. The right to hunt game now belongs to the sportsman, but it was only a few years ago that thousands of men in California made their living, legally, by shooting wild game for the market, and their annual bag probably exceeded that of the sportsman. Their occupation may now have fallen into disrepute, but in the years that these men hunted they built up a knowledge of the animals they hunted which is probably seldom exceeded by that of the present day sportsman.

I have interviewed seven of these market hunters who did most of their hunting between 1880 and 1901. In this period there were at least nine market hunters residing in Lafayette, Contra Costa County, and an estimated two hundred operating within the bounds of the County. Most of these hunters shot quail, ground squirrels and brush rabbits.

Quail shooting started in September. By this time the young were full grown and family groups had combined to make large coveys. Hunting was best in cold damp weather when coveys drew together to make large flocks of several hundred. Also, it was more comfortable to hike in cool weather and the dog worked more effectively. All the hunters I interviewed hunted exclusively with 12-gauge shotguns. They used brass shells which they loaded with 3¼ drams of black powder, two hair wads, one ounce of number 8 shot and a wad to seal the end. The cost was about one cent a shell. Mr. Bart Gerow ground up pellets of blasting powder in a coffee grinder, cut his own wadding, and got his shot from a bottle washing plant, which cut his expense to about one-quarter of a cent a shot.

Hunters in Contra Costa County shot their birds on the wing, or occasionally on the ground when there was opportunity to pot several birds in one shot. There was no "ground sluicing" with large barreled shotguns at springs as was generally the practice in other areas. Fisher says in his report on birds of the Death Valley survey (North American Fauna, vol. 7, p. 28) that two men pot hunting for the market were reported to have killed 8400 quail in one week at a solitary spring in the Temploa Mountains. Welch (CALIFORNIA FISH AND GAME, vol. 14, p. 126) says that there were as many as 20 trappers in the vicinity of "Lone Tree Canyon" in the San Joaquin Valley averaging about 100 dozen quail per week per man. He states that in the vicinity of Paso Robles market hunters who netted quail at springs were able to ship several hundred quail twice a week. The market hunters I inter-

[1] Submitted for publication, October, 1938.

viewed said that traps were used only by farmers or campers in Contra Costa County. The hunters destroyed any traps they happened to find.

A good dog was of course indispensable, but certain methods were used to supplement the work of the dog. Flocks were located by the use of a "quail caller." This was a green stick about the size of a lead pencil with a split from one end to the middle. A green laurel leaf was inserted into the split and the edges of the leaf were trimmed flush with the surface of the stick. When held to the lips and blown, the "ca-ca-coo" call of the quail could be easily imitated and answers would be received from members of every flock within hearing distance. The hunter tried to get between birds in the open field and the brush. A quail that had "frozen" in the grass and would not fly could often be raised by the hunter if he would kick a bush and blow through his lips making a whirring sound like a flying quail. Any quail within fifteen feet would immediately fly to join the bird it supposed had flown.

As soon as there was a lull in the shooting, the quail were cleaned. One deft movement of the finger disemboweled a quail so a knife was not necessary. After the day's hunt the birds were strung on a string and hung in a cool place. Twenty-five to 30 birds was a good day's bag, with usually 6 to 12 cottontail or brush rabbits in addition. Quail brought $1 to $1.75 a dozen in Oakland markets. Rabbits brought $1.25 to $1.50 a dozen. Ground squirrels were not found in quail habitat, and usually so many were bagged that their weight and bulk made it difficult for the hunter to make his way through brushy country, so squirrel hunting was carried on separately. Usually about eight to ten dozen squirrels were shot in a day, so it was necessary to make caches at intervals to be picked up at the end of the day's hunt. Squirrels brought the hunters $0.60 a dozen unskinned or $1 a dozen skinned. They were sold by the markets as "rabbits." The hunters shot five days a week and took their game to market on Wednesdays and Saturdays. After market hunting for quail was prohibited in 1901, the birds brought poachers $5 to $6 a dozen. One hunter said that he had hunted for the market as late as 1922.

Hunting stopped in March when quail coveys broke up and the birds started to pair off. Ground squirrels at this time became too fat to make good food. Haying season arrived in April and labor then was in demand, so there was only a short time interval between periods of steady employment for the market hunters.

A day's quail hunt seldom, if ever, took the hunter more than five miles from his home. There were so many quail then that it was not necessary to travel far to find large coveys. Mr. Bill Gerow, when asked what he thought of the quail population in the vicinity of Lafayette remarked that "there aren't enough quail now to go out after them." His father hunted from 1862 to 1868 with a muzzle-loading shotgun and usually brought in six to eight dozen quail each day. Bill started hunting in 1876 with a muzzle-loader, got a breech-loader in 1880, and hunted irregularly until 1900. His average bag was two to three dozen quail. His brother Bart Gerow made the estimate that in good quail country near Lafayette there could be expected to be about 50 quail to each 25 acres. This estimate he admitted was crude but indicative. Mr. Wilbur Crow of Lafayette thought that there is one quail now where there were a thousand quail in 1890, but when asked

whether he would like to be quoted admitted that his estimate might be a little high. Mr. J. L. Mullikan of Happy Valley, near Lafayette, aptly remarked, "Every little canyon was full of birds when I was a kid—and I don't think that any of them died of old age."

Although estimates varied, all agreed that quail numbers had decreased continually throughout their experience. All believed that

Fig. 21. Mr. Bart Gerow with his quail gun that he used 50 years ago for market hunting. Photograph by author.

the heavy drain on the quail population by market hunters contributed greatly to depletion, but most of them were at a loss to explain why quail have not come back since market hunting was outlawed in 1901, and especially in the last few years when farmers have allowed very little hunting by sportsmen in the Lafayette region. A large part of the hills near Lafayette is owned by a water company, and hunting

there is strictly forbidden, yet quail seem to be no more numerous there than in other regions.

Mr. Bill Gerow claimed that he noticed a decided drop in quail numbers from 1880 to 1885, coincident with the introduction of breech-loading shotguns, and with the conducting of extensive squirrel poisoning campaigns. Mr. John M. Walker of Walnut Creek remembered when ground squirrels were very scarce in Contra Costa County. In 1872 a decided increase was noticed, and by 1880 the country was overrun by them. He could give no reason for this sudden influx. Mr. Mullikan said that squirrels were once so abundant in certain fields that it often looked from a distance as though the surface of the earth were moving. Mr. Bart Gerow told of strewing barley poisoned with cyanide around the edge of a 40-acre potato patch one morning at three o'clock and returning three hours later to count 400 dead squirrels. Another time he counted 50 in one buckeye tree eating buckeyes. The fact that market hunters often shot as many as 12 dozen squirrels in one day's hunting indicates that squirrels must have been exceedingly numerous in this county.

Mr. Gerow's father was poisoning ground squirrels with strychnine as early as 1876. He held one of the earliest patents on a ground squirrel poison. His activities ranged from Sonoma County to as far south as Santa Barbara County. He mixed wheat with strychnine in ton lots and sold it to the farmers for five cents a pound. This was strewn in the fields by a man on horseback. Mr. Gerow can remember seeing many dead quail in the fields after poisoning campaigns. His father recognized and admitted the fact that strychnine killed quail. Now squirrel poisoners use whole barley which is reputedly not eaten by quail. At present squirrels are again scarce in Contra Costa County.

All the men interviewed agreed that quail food is as plentiful now as before, and that there is more cover now than existed before 1900. The two factors that were considered as most seriously affecting the present quail population are their destruction and the lack of water. Mr. Bart Gerow believed that jays are now more numerous than formerly because market hunters recognized the jay as an enemy to young quail and shot them every time they had a chance. Once while plowing a field Mr. Gerow watched a pair of quail, followed by about a dozen downy young, run out from the dense cover of weeds onto the recently plowed ground. Three California jays swooped down from nearby trees and each carried away a young bird in its beak.

The Cooper and sharp-shinned hawks, or "blue darters," were recognized by all as important predators on quail. Several had seen hawks catch quail in flight and one had shot a hawk as it was killing a bird that he had injured.

Mr. George Allen of Oakland found a nest with a full set of pipped eggs but ants had entered the tiny holes and eaten each embryo. He believed that ants destroy many more nests than is usually suspected. The hunters believed that snakes were responsible for the destruction of many sets of quail eggs. One had seen an alligator lizard catch and swallow a small quail. Mr. Walker said that snakes now are comparatively scarce in Contra Costa County because so many have been killed by eating squirrels that had been poisoned by thallium.

The opinion was unanimous that the amount of water in Contra Costa County has decreased tremendously in the last thirty years. Formerly there were springs at short intervals all over the county and many streams ran all year. Now even the largest springs seldom run after July or August, and only in unusually wet years, such as the one of 1938, do the streams carry water throughout the year. In 1936, Mr. Charles Twining in a survey of over a hundred ranches in Contra Costa County found only one which had a reliable water supply throughout the year. Mr. Bart Gerow believed that quail nests are often placed near springs which dry up before the eggs hatch. He has seen parent quail lead their young to a cattle watering trough, hop up to the rim of the trough and drink, then lead the young away although they had not had a chance to drink. Mr. Gerow also believed that quail are at an additional disadvantage when watering at those few springs that are left, because cattle have gathered around these spots and so thoroughly destroyed the surrounding vegetation that the quail have little chance to escape to cover when attacked by jays or hawks.

Opinion among the market hunters I interviewed differed as to the time of day that quail drink. Two thought that they drank only at noon, one thought that they drank once at about 10:00 a.m. and again at 3:00 p.m., one thought they drank at 2:00 to 3:00 p.m., and another thought they drank shortly after dawn. Two others believed that they drank irrespective of time and that the amount of drinking depended somewhat on weather conditions. This last opinion is confirmed by the findings of Rahm (CALIFORNIA FISH AND GAME, vol. 24, p. 145), who has observed that quail drink at various times of day.

Mr. John Walker thought that quail would travel several miles to water. The other men would not express an opinion on this subject. It appears that this is a critical question which must be answered before the relative importance of water scarcity in affecting quail numbers can be determined.

The market hunters were unanimous in the opinion that quail would not readily desert their nests. Mr. Peter Carpenter has plowed around quail nests leaving a narrow island of grass, and the females did not desert. Mr. Walker several times has taken a quail nest out of a haycock and moved the hay, leaving the nest in the stubble with a scant canopy of grass. The parent in many cases has returned to incubate the eggs. Mr. Mullikan claimed that he moved a quail nest as far as 30 feet from its former position in a haycock and the parent returned. Mr. Bart Gerow said that he moved a haycock with a nest inside more than 100 feet, leaving both intact, and that the parent returned to incubate the eggs. Most of the hunters throught that shooting of other animals, such as jays, during the quail nesting season would not cause the quail to desert their nests. Mr. Walker believed that ordinary disturbances would not as a rule affect incubating quail, but that in heavily hunted areas, where the quail were deathly afraid of shooting, the sound of gunfire might well cause the birds to abandon their nests.

It is significant that none of the market hunters could definitely say just what factor is working to hold down quail numbers. Everyone agreed that a thorough field investigation in this area might soon disclose this factor, and that as a result this work on the quail's behalf might help bring back these birds to their original numbers.

# OCCURRENCE OF THE WOLF-FISH, *ALEPISAURUS AESCULAPIUS* (BEAN) IN SOUTHERN CALIFORNIA [1]

*By* Phil M. Roedel and Howard McCully
*California State Fisheries Laboratory*
*Division of Fish and Game*

A specimen of the wolf-fish, *Alepisaurus aesculapius* (Bean) was captured in the surf at the Hollywood Riviera Beach Club, Redondo Beach, Santa Monica Bay, California, on June 13, 1938. This apparently constitutes the second record of this fish south of Point Conception, it having been previously reported from Laguna Beach by W. A. Hilton (Journ. Entom. Zool., 1916, 8:80-82, 2 figs.). In central California waters, the fish, while not common, appears frequently enough so that it occasions little comment when it is taken. There are numerous records from the North Pacific.

The Redondo specimen, when first seen, was swimming feebly in water no more than knee-deep. A bather struck the fish about the head with a stick and brought it ashore, turning it over to the California State Fisheries Laboratory for identification twenty-four hours later. Many of the California specimens have likewise been captured in the surf.

The following measurements were taken prior to preservation. Because of the loose articulation of the vertebral column, the standard and total lengths should be regarded as approximate. Standard length, 115 cm.; total length, 130 cm.; length of head, 19.1 cm.; length of lower jaw, 14.3 cm.; snout to insertion of dorsal, 19.7 cm.; length of dorsal base, 71.0 cm.; length of anal base, 11.3 cm.; longest pectoral ray, 20.9 cm.; longest ventral ray, 5.5 cm. Ray counts were as follows: D, 39; A, 18; P, 14; V, 8. The specimen, a female, contained many small undeveloped eggs. The lower jaw and the teeth were badly damaged in capturing the fish, while all the fins, especially the high weak dorsal, were similarly in poor condition.

The fish was fairly free of parasites, containing one embedded in the flesh near the posterior end of the abdominal cavity, a threadworm in the abdominal cavity, and a number of encysted parasites in the wall of the stomach. Several egg masses were attached to the gills. Selle (California Fish and Game, 1925, 11:188) reports a Monterey specimen, as well as others, as being infested with parasitic worms (*Tetrarhynchus*).

The stomach contents proved of unusual interest. The huge gastric caecum was crammed with material, primarily small fishes and cephalopods in various stages of digestion. A cusk eel (*Otophidium taylori*), about 25 cm. in length, was the largest individual. This specimen differed from all the described specimens in having an orange ground

[1] Submitted for publication, August, 1938.

color, possibly an indication that it lived at a greater depth than those hitherto taken. More interesting were the partially digested remains of five *Trachypterus rex-salmonorum*, the strange and infrequently seen "king-of-the-salmon." Largest of these was about 20 cm. in length when alive, whereas the smallest was perhaps half that size. Other fishes, almost all under 5 cm. in length, included 21 *Pneumatophorus diego* (Pacific mackerel); 33 *Sebastodes* (rockfish), one referrable to *jordani*, two possibly to *diploroa*, and 30 probably to *saxicola;* seven flatfish representing three species, one of which is thought to be a variety of turbot; one pipe-fish, perhaps 8 cm. long; seven representatives of the family Zaniolepididae, of which four were *Zaniolepis latipinnis* and three the rare *Xantocles frenatus;* and the unidentifiable remains of some 20 additional small fishes. Cephalopods were represented by 66 small octopi, *Polypus hongkongensis*, the largest of which measured 60 mm. with tentacles extended and the smallest 30 mm., as well as five young squid, two of which were identified as *Loligo opalescens*, and two as *Onychoteuthis banksii*. A number of tunicates and a few small shrimps and amphipods made up the balance of the stomach contents.

The intestinal tract is in every respect similar to that of *A. ferox* as described by Günther (Cat. Fishes Brit. Mus., 1864, 5:422). The stomach forms an extremely long blind sac, the walls of which are dark blue. The pyloric opening lies very near the aesophagus. The anterior end of the intestine is much dilated. The intestine gradually tapers to the anus, and it is divided into two equal portions by a circular valve. Above this valve the lining is much thicker than below. The whole of the lining is reticulated, the horizontal walls being higher and thicker than the longitudinal. The cells in the upper portion are smaller, deeper, and thicker walled than those in the posterior half. The vent is situated close behind the ventral fins.

This specimen and all of the material found in its stomach have been preserved at the California State Fisheries Laboratory.

A specimen taken off San Francisco during the summer of 1938 offers some interesting comparisons. A male, 80 cm. in standard length, its ray counts were D, 31; A, 15; P, 14; V, 9. This fish was even more free of parasites than was the southern California specimen. There were a number of worms free in the abdominal cavity, one large flatworm in the anterior portion of the intestine, and one or two parasites in the gastric walls. The stomach was almost empty of food; a small comb jelly and two or three minute crustaceans were its only contents. This fish is now in the Stanford University Collection.

Use of the name *aesculapius* for this species is open to question. Crawford (Copeia, 1925, 147:73-75) discusses the validity of the species described from the Pacific Coast (*aesculapius, borealis,* and *serra*) and asserts that all are referrable to *ferox*, which is usually regarded as an Atlantic form. His argument revolves in the main about statements made by Günther (*op. cit.*: 421), namely, that the loose articulation of the vertebral column makes specific separation on the basis of body proportions unreliable, while at the same time the dentition is equally useless as the teeth are constantly changing. Subsequent northern Pacific records continue the use of the name *ferox*. Further, Jordan and Sny-

der (Smith. Misc. Coll., 1903, **45**:235) regarded specimens from Japan and the Pacific Coast of America as *ferox*.

Before determining to retain the name *aesculapius* for the Pacific specimens in question, the authors consulted all available literature and examined four specimens. Two were those recently taken in California and discussed in this paper, the third was captured near Punta Arena, California, while the fourth was taken in Misaki Sagani Bay, Japan. All but the Redondo specimen are in the Stanford University collection, the Japanese fish being one of those discussed by Jordan and Snyder (*loc. cit.*). As they indicated, it differed in no respect from the California specimens. Unfortunately, no specimens from the Atlantic were available.

Continuance of the use of the name *aesculapius* on our part is tentative pending further information and a direct comparison of specimens from each ocean. With one exception, the specific characters ascribed to *ferox* were equally applicable to the four Pacific individuals. This single exception lies in the gill raker counts. Jordan and Gilbert (Bull. U. S. Nat. Mus., 1882, **16**:888-889, quoting Bean's unpublished manuscript) state that they number 23 in *aesculapius* and 27 in *ferox*. Other writers do not mention this point. In two of the specimens which we examined the gill rakers numbered 23, in the other two, 21 on one side and 24 on the other. Unless this differentiation is shown to be invalid, we feel that the name *aesculapius* should be retained.

The status of *borealis* and *serra* is beyond the scope of this paper. Both are supposed to differ trenchantly from *aesculapius* and *ferox* in having about 13 ventral rays as opposed to the 10 or less of the latter two.

FIG. 22. The *N. B. Scofield*, new research vessel of the California Division of Fish and Game. Photograph by D. H. Fry, Jr.

## N. B. SCOFIELD

The recently commissioned research vessel, *N. B. Scofield*, was expressly designed and built to carry on marine fisheries research for the California Division of Fish and Game. This boat is 100 feet, 6 inches long, over all, with 24-foot beam and 13-foot, 9-inch depth. She is a compromise of all the major types of fishing boats used on this coast, so built that she will be able to fish any of the more important types of gear used in California. Thus, the afterdeck is clear, permitting the operation of a purse seine or ring net. Likewise, the freeboard is low aft, permitting live bait fishing from racks on the stern. The vessel has three experimental fish holds, each of which will carry between seven and eight tons of iced fish. Each of these compartments is refrigerated both by the direct expansion system and with brine, so that either may be used experimentally. The vessel will carry a crew of eight, and in addition two or three laboratory staff members. She is powered with one 350-horsepower heavy duty Diesel engine; a supercharger gives an additional 70 horsepower to the main engine. She is equipped with two high-speed Diesel auxiliary engines rated at 110 horsepower at 1600 r.p.m. Each of these auxiliaries is direct connected to a 40 K.W. generating set, and all winches and machinery are run electrically. There are two ammonia compressors: one 2-cylinder 5x5 to supply refrigeration to the fish holds and one small single 3x3 to supply refrigeration to the cold-storage boxes and the air-conditioning unit. There are two winches aboard—one large one in the forward end of the deckhouse, driven by a 30-horsepower electric motor for the operation of the otterboard trawls; and one small one at the after

end of the boat deck intended for the towing of plankton nets and other light equipment. The accommodations, with the exception of the master's cabin, are all below decks. Four staterooms with bunks for two people in each are located forward of the machinery space. After provision had been made for all machinery and working facilities, this was the only space available, and to offset the heat of the tropics, a small air-conditioning unit was installed to cool (or heat) the accommodations. There is a forecastle for two men under the forecastle head. Below decks and forward of the accommodations is a spacious net and gear storage locker for storing the various types of fishing nets and other gear used in the course of the work. The vessel is equipped with all modern conveniences, including a radio direction finder, sonic depth finder, radio telephone and wireless set. The vessel is equipped with two laboratories—one is designed for the handling and biological examination of samples of fish, and the other is designed for clerical, chemical and microscopic work. She will carry two small boats—one an 18-foot net skiff and the other an 18-foot power launch.

The *N. B. Scofield* will be used constantly in the study of the major fisheries of the State, principally the sardine, mackerel, tuna and flatfish. The program for the first year's operations calls for two extensive tuna trips, investigation of the trawl fishery in northern California, determination in the fall of the main rearing grounds for the sardine, and in addition other work will be done incidentally as opportunity offers on the various trips. As a result of the heavy losses of tuna sustained by the industry during the past few years, experimental work will also be done on refrigeration. In order to carry out this experimental work, the vessel is equipped with the latest refrigeration equipment including 24 distant reading electric resistance thermometers.

At San Diego on the afternoon of December 17, 1938, the *N. B. Scofield* was officially launched in the presence of the five members of the Board of Fish and Game Commissioners of California. In attendance were representatives from all of the bureaus of the Division of Fish and Game, the Department of Natural Resources and other State departments, Federal departments, foreign governments and the marine stations of the educational institutions of the State, as well as members of the fishing industry and sportsmen's organizations.

Mrs. E. C. Moore, wife of the President of the Board of Fish and Game Commissioners, christened the vessel with these words, "I christen thee '*N. B. Scofield.*' May the God of Waters watch over thee!"

A short speech of dedication by Herbert C. Davis, Executive Officer of the California Division of Fish and Game, was a most appropriate and touching tribute to the life work of the man for whom the new vessel was named.

The man, Norman Bishop Scofield, was born in Washington, Iowa, November 24, 1869, and prepared for college at the local Academy, where he showed a strong inclination toward being a field naturalist. He entered the State University of Iowa in 1890, but because of the distinguished zoology faculty at a new western university, he decided to transfer to Stanford University in 1892. Here he studied fishes under Dr. David Starr Jordan, President of the University, and Dr. Charles H. Gilbert, head of the Zoology Department. He graduated

in zoology in May, 1895, with the famous Pioneer Class of Stanford and left immediately with Dr. Alvin Seale on a fish collecting trip into Alaska and Bering Sea. Working up this collection was part of the preparation for a Master's Degree in Zoology, which was granted

FIG. 23. N. B. Scofield, Chief, Bureau of Marine Fisheries.
Photograph by Barboni Studio.

at Stanford in May, 1897. On July 4, 1897, Mr. Scofield married Stella A. McCray, a Stanford zoology student from the class of 1898.

In 1897, N. B. Scofield and Cloudsley Rutter were chosen to carry out an investigation of the salmon of the Sacramento River. These studies, sponsored by the United States Fish Commission in coopera-

tion with the California Fish Commission, constituted one of the early life-history studies undertaken on this coast for the purpose of directly aiding in the management of the fishery. Parts of the results were published in the early Biennial Reports of the California Fish Commission. From 1897 to 1899, Mr. Scofield was employed by the California Fish Commission as special investigator engaged chiefly on salmon work, but in 1897 his report on the Chinese shrimp fishery described conditions in this fishery and made recommendations for legislative action.

After an absence of several years in the East on personal business, Mr. Scofield returned to California, and in 1908 was again employed by the California Fish Commission for a study of the runs and abundance of striped bass of San Francisco Bay and the spawning and hatching of striped bass eggs at the Bouldin Island Hatchery. Less extensive studies included reports on the trawl fishery outside the Golden Gate, lampara fishing in Monterey Bay, and the effects of paper mill refuse upon trout eggs and fry in the Truckee River.

By this time the work in California had been expanded to include game, but the California Fish and Game Commission was still a small organization with the office in San Francisco consisting chiefly of one room with a table at which deputies wrote reports and upon which local sportsmen displayed their limits of game and fish. A chief deputy carried the duties of our present executive officer, and there was as yet no separate department to look after the commercial fisheries of the State.

In his work as fisheries investigator for the State, Mr. Scofield saw the necessity for planned management of the fisheries and conceived what at that time was looked upon as a novel idea—an administrative policy determined by and based upon the results of research work, but the research was to furnish the answers to administrative problems rather than content itself with rather aimless rambles in the field of pure science. Because most of the research of former years had no very practical application, this new idea seemed revolutionary at first but gradually more and more people began to realize that the results of fisheries investigations in California were actually being used as the evidence to support the requests for legislative regulation of the fisheries. Facts were being presented at Sacramento that were beginning to supplant offhand opinions resulting from casual observation, so this new idea of administrative policy based upon facts instead of guesses did not seem so fantastic after all. Others came to the support of Mr. Scofield in his desire to establish a carefully planned management program for handling commercial fisheries problems, and he became the "spark plug" and administrative head of a new department of the Fish and Game Commission. This Department of Commercial Fisheries, created in 1914, later rechristened the Bureau of Marine Fisheries, was conceived by and has grown up around one man who had vision, earnestness and determination. The establishment of a conservation program based upon research for the management of marine fisheries has been the life work of Norman Scofield, and he has had the satisfaction of seeing his dream fulfilled not only in California but in other sections of America to which his ideas have spread.

The fledgling Commercial Fisheries Department became a financially sound, going concern with the establishment of a fisheries privilege tax, a special tax paid by fish packers for the privilege of using State property as the raw material of their packing plants. An adequate statistical system for recording the fish catch of the State was inaugurated to serve as a basis for future research work on the changing abundance of the various marine species, and in June, 1917, the California State Fisheries Laboratory was established to serve as the center for marine fisheries investigations of the State.

When offered a position of wider scope and greater prestige, Mr. Scofield declined on the ground that the fisheries program in California was not yet firmly established and might not survive some possible political upheaval and that the cause of fisheries conservation might be as well advanced by a clear demonstration in one state as by a thinner solution of the ideas spread over many states. In addition to his work in California, Mr. Scofield served on the advisory board to the United States Bureau of Fisheries for a number of years. In 1926, when the International Fisheries Commission (United States and Mexico) was formed, Mr. Scofield served as one of the U. S. Commissioners during the time the treaty was in operation.

The persistent effort of one man over a period of forty years has borne fruit in the accomplishments of the present Bureau of Marine Fisheries. In recognition of these years of service the California Division of Fish and Game abandoned its rule of giving the vessels of its fleet the names of fishes and bestowed upon the new research vessel the name of this pioneer of fisheries conservation management based upon research. To quote an excerpt from the speech of Executive Officer Herbert C. Davis at the launching of the vessel:

"Today in 1938 we find the grand old man of the marine fisheries nearing retirement to a well earned rest. The State of California has built a fine research vessel, a veritable floating laboratory, which brings to a focus the results of Norman Scofield's life time of work. The motor vessel, *N. B. Scofield,* is dedicated to him."

# EDITORIALS AND NOTES

VOLUME 25 JANUARY, 1939 Number 1

## THE 1938 SALMON CATCH [1]

Commercial salmon catches for the 1938 season have been small for the State of California as a whole, with a total poundage of 3,793,981,[2] as against a comparable figure based on the average yearly commercial catch over the five-year period, 1933-1937, of 4,731,000 pounds.

The first open season of any consequence in the ocean occurred off Monterey where a few pounds of fish were taken in March, with better catches in April and May, and a slacking off until the season closed on July 15. The total take for Monterey Bay, including landings at Santa Cruz, was 199,474 pounds as compared to the average yearly catch over the five-year period, 1933-1937, of 422,359 pounds. In terms of these figures the Monterey catch was about one-half as good as previous years.

The early ocean trolling season off San Francisco during February and the first half of March, upon which fishermen had based high hopes, was a dismal failure. There were only 6623 pounds taken against a long remembered, but unusual, catch of 30,000 pounds made many years ago during the same time of year. The season again reopened off San Francisco the first of May and continued on to the closing date of August 16, plus five days of fishing on an injunction order.[2] The total catch for this area for the 1938 season was 109,966 pounds as compared to landings of 1,108,000 pounds in 1937. This was a percentage decrease of over 90. The average catch for this area during the five-year period, 1933-1937, was 537,778 pounds per year. The 1938 catch showed a decrease of about 80 per cent from this average.

Contrary to salmon catches elsewhere in the State of California, the take on the Sacramento River in the 1938 season surpassed its previous year's landings. The early spring season (January 1-June 15) recorded a take of 63,813 pounds; but adding the fall season, August 1 to its closing date September 16, plus six days of fishing on an injunction order,[2] the total catch in the river region was 1,650,780 pounds for the entire 1938 season. This figure is in excess by some 917,780 pounds over the 733,000 pound average for the river during the five-year period, 1933-1937. However, this large catch on the Sacramento River is the result, no doubt, of the large numbers of salmon

[1] A preliminary report on the 1938 salmon catch appeared in the October, 1938, issue of *California Conservationist*.

[2] This total includes 695,376 pounds taken after the regular season closed, under two court injunctions which extended the season. Under one injunction, fishing continued on the Sacramento River from September 17 to September 22. A total of 664,664 pounds was taken during this period before the injunction was dissolved. In addition, an after-season catch of 30,712 pounds resulted from the order extending the ocean season off San Francisco. Deduction of salmon caught under injunction orders leaves a total for the State of 3,098,605 pounds.

that escaped the fishermen off Monterey and San Francisco, and so were able to get into the bay and river to swell the catch there.

The salmon catch of the entire north coast region from Point Reyes to the Oregon line was a disappointment from all sides. The season opened April 1 with reasonably good catches made by the ocean trollers, but during May the catches were very poor. The months of June, July, August, and to September 15, when the season closed, were characterized by spotty fishing—a few good days and then many days of scouting for salmon. As a result the total take for the season was 1,833,078 pounds, a percentage decrease of 53 from the 3,934,000 pounds taken in the same regions in 1937; and with a 48 per cent decrease from the five-year (1933-1937) average of 3,575,000 pounds.

For many years the north coast regions have been the mainstay of the salmon fisheries. The other regions, such as Monterey Bay and San

FIG. 24. Salmon trollers at anchor in Trinidad Cove, Humboldt County. The two boats in the foreground are from Seattle and are typical of the many boats that come down from Oregon and Washington to participate in the California salmon fishery. Photograph by Richard S. Croker, July, 1937.

Francisco, have fluctuated markedly in size of catches in different seasons. However, the catches from the north coast regions have been reasonably steady, with minor fluctuations from year to year. If a large majority of the salmon supplied to the north coast ocean regions are reared in the streams adjacent to these regions, it is natural that the catch in these regions has and will hold up to a fairly high level. Because the spawning streams of Sonoma, Mendocino, Humboldt, and Del Norte counties are reasonably unobstructed and not polluted, ample spawning grounds are available. On the other hand, those fish which migrate into the Sacramento-San Joaquin system are confronted with many obstacles, such as impassable dams which diminish the spawning areas, and the seaward migration of the young is made hazardous by innumerable diversions.

Salmon conservation depends basically on only one factor, that is, that sufficient adult salmon are allowed to spawn, so that the popu-

lation can be perpetuated at a reasonably high level. Destruction of the spawning reserve by any means, whether it be by overfishing, pollution, impassable dams or any other factor, can result in but one condition: the eventual disappearance of salmon from our waters.—*G. H. Clark, California State Fisheries Laboratory, October, 1938.*

## GIFT FROM PERRY B. CLARK TO LIBRARY OF CALIFORNIA STATE FISHERIES LABORATORY

To Mr. Perry B. Clark of the U. S. Food and Drug Administration, San Francisco, the Division of Fish and Game wishes to express their appreciation of a gift of 712 publications to the library of the California State Fisheries Laboratory, Terminal Island. This literature was a part of the library of the late Mr. Wallace Adams, formerly with the Steinhart Aquarium of San Francisco and later chief of the Division of Fisheries, Bureau of Science, Philippine Islands, who bequeathed his library to Mr. Clark. Because of the interest of Mr. Adams and Mr. Clark in fisheries research work and also because of the close friendship of both these men with the Laboratory staff members, Mr. Clark kindly offered these books to us. He not only thought the books would be of greater benefit if placed in our library, where any one interested may have access to them, but that it also would have pleased Mr. Adams. The Laboratory's library is very fortunate in having this wealth of fisheries literature added to its shelves. We are therefore very grateful to Mr. Clark for his generosity.—*W. L. Scofield, Supervisor, California State Fisheries Laboratory.*

## WPA CLERICAL PROJECT

The California State Fisheries Laboratory in the name of the California Division of Fish and Game wishes to take this opportunity of expressing our gratitude for the liberal assistance given us by the Federal Government under the Works Progress Administration in the form of clerical aid and statistical tabulations under Project No. S9799. We have had the benefit of the work of four clerks during the life of this project and the accomplishment of these workers has been a most welcome assistance to us.

This project No. S9799 is in reality the continuation of earlier and similar WPA clerical projects in the past. Originally under SERA a clerical project was set up for the Laboratory in May, 1935, and this was continued that same year under WPA, and we have benefited from the Federal assistance given us without a break to the present time. As a result of this aid, we have been able to accomplish much that would have been impossible for us otherwise.—*W. L. Scofield, Supervisor, California State Fisheries Laboratory.*

## SURVIVAL OF FISH AFTER PACK TRANSPORTATION

A great many trout are transported by pack horse each year to the waters in which they are to be planted. Arrived at their destination, the young fish are placed in the water, observed for from ten minutes

to one hour and, if all seems to be going well with them, the operation is regarded as a success.

That there might be some effect of pack transportation which, while not showing immediately, might make itself felt several hours or days later, is a possibility which heretofore no one has been able to deny. To test for such a delayed after-effect, two experiments were carried out this summer in the Lake Tahoe region.

In the first, two cans of rainbow trout from Tallac Hatchery were loaded on a horse provided by the Mount Ralston Fish-Planting Club on a sunny August morning, and packed about the countryside for approximately two and a half hours. This is an average duration for pack hauls in this region, and every effort was made to approximate normal conditions. The fish were 18 to the ounce in size, and 23 ounces were put in each can. They were re-iced half way through the journey, which is standard practice for a trip of that length. They were then returned to the hatchery, where they were placed in separate troughs so that they could be carefully watched. Six days later, one had died; the rest were in good shape.

In the second experiment, Tahoe Hatchery was the base, and the pack animal was kindly contributed by "Bud" Slater, packer, of Tahoe City. The fish in this case were Loch Leven trout at 58 to the ounce, and eastern brook at 41 to the ounce, one can of each, 25 ounces in each can. The total duration of this journey was two hours and 45 minutes. The fish started at a temperature of 40 degrees, reached 59 at the end of an hour and a half, were iced down to 49, and had reached about 56 again by the end of the trip. They were held in the hatchery troughs for seven days thereafter; one of each species had died, while the rest were in good shape.

The mortality being no greater than might normally be expected from trout held in hatcheries, the tests indicate that pack transportation, in itself, produces no deleterious after-effects on young rainbow, eastern brook, or Loch Leven trout, when conducted along the lines at present considered as standard practice.—*Brian Curtis, Bureau of Fish Conservation, California Division of Fish and Game, September, 1938.*

## SURVIVAL OF TRANSPLANTED PIUTE TROUT

The piute trout, most recently discovered of the California salmonids, was first brought to the attention of the public by J. O. Snyder in 1934 ("A new California trout," California Fish and Game, vol. 20, pp. 105-112). He named it *Salmo seleniris* because its coloration suggested the lunar rainbow.

Like the famous golden trout, it is an isolated native of high mountains. Each was cut off from its parent stock centuries ago by impassable falls, but whereas the golden derives from the rainbow, the piute derives from the primordial Carson River cutthroat.

Isolated in upper Silver King Creek, and very easily caught in those waters at the proper time and season, there was danger of the piute's extinction by over-eager anglers. To prevent this, Silver King Creek above Lewellyn Falls was—and is—closed to fishing. As a further safeguard and as a possible fish cultural measure, it was

decided that it would be wise to make a transplant of the stock to some other body of water, and with the aid of the Mount Ralston Fish Planting Club, whose members helped secure the fish and whose pack train transported them, this was done in 1937.

The Leland Lakes were chosen to receive the plant. They are situated in El Dorado County, north of Wright's Lake and west of Lake Tahoe's Emerald Bay, at an elevation of about 8000 feet—approximately the same as the piute's native stream. The lakes were barren, in so far as fish life was concerned, on the morning of August 30, 1937; on the evening of that same day, the upper lake contained 200 piute fingerlings and the lower lake 200 piute adults.

A year later, some of the Mount Ralston members who had taken part in the original transplanting operation undertook to find out how their fish had come through the winter. On August 19, 1938, Messrs. George Olmstead, Ted Moore and Harvey Holland started on the arduous trip to the Leland Lakes, and on August 21, they returned. They carefully recorded their observations, which are briefly reported below:

In upper Leland Lake, seven 4-inch trout and one 6-inch trout were seen;

In the creek between the lakes, two 7-inch trout;

In the lower lake, two 8-inch trout;

In the outlet, 100 feet below the lower lake and just above impassable falls, three 8-inch trout.

No fish of the year were seen. The adults, as near as the observers could tell, had retained the typical coloring of the piute species.

The conclusions to be drawn are: that both young and adults survived; that the young had reached a size of about four inches a year after the plant; that the adults had done a certain amount of migrating both up and down stream; but that no successful spawning had taken place, unless the abnormally hard winter had so delayed spawning that the fry were not yet out of the gravel.—*Brian Curtis, Bureau of Fish Conservation, California Division of Fish and Game, September, 1938.*

## 1938 RECOVERIES OF CALIFORNIA SARDINE TAGS IN NORTHERN WATERS

From July to November, 1938, 70 California sardine tags were taken in the fisheries of British Columbia, Washington and Oregon. Of these tags, British Columbia returned 41, Washington 14, and Oregon 15. From the entire group of 70 tags, 49 had been put out in southern California waters in 1936, 1937 and 1938, and 21 in central California during the summer and fall of 1937. The fish bearing 5 of the tags were released in March, 1936, and had been out almost 2½ years. The shortest time between release and recovery was from February 14, 1938, to July 31, 1938. The sardine with this tag was freed off Newport, in southern California, and retaken by British Columbia fishermen. It had traveled at least 1000 nautical miles in 168 days, an approximate average of 6 miles per day.

During the summer of 1937, 30 California tags were recovered in northern waters. The reasons for the greatly increased returns in

1938 involve several factors: more tagged fish have been released off California, more recovery magnets have been installed in the northern plants, and the total fishing effort has increased.—*John F. Janssen, Jr., California State Fisheries Laboratory, November, 1938.*

FIG. 25. A 1090-pound leatherback turtle caught near San Pedro, California. September 10, 1938. Photograph by Donald H. Fry, Jr.

## GIANT LEATHERBACK TURTLE TAKEN NEAR SAN PEDRO, CALIFORNIA

On September 10, 1938, the crew of the fishing boat *IZU* discovered a huge leatherback turtle (*Sphargis coriacea*) less than a quarter mile off Point Vincente. They harpooned the beast, then finally subdued him and got him aboard. The turtle was stored for a while at the Union Ice Company's fish freezing plant in Wilmington, and then was turned over to the Cabrillo Beach Museum at San Pedro.

The weight of the turtle was 1090 pounds. We do not know if this is a record, but it is unusually large, even for a leatherback, the largest of all species of turtles. Leatherbacks are wanderers in tropical and subtropical seas all over the world. They are common nowhere and are quite rare this far north.—*Donald H. Fry, Jr., California State Fisheries Laboratory, September, 1938.*

## CATFISH IN BIXBY SLOUGH

Bixby Slough is a shallow fresh-water marsh located between the towns of Wilmington and Lomita in Los Angeles County. The water surface varies in area from a few acres during a series of dry years to more than 360 acres in March of 1938, but large or small, it is a welcome landing field for migratory waterfowl, and even the local sea-gulls and land birds make such full use of it that many people have urged the establishment of a bird refuge. Desirable as this would be, the land is held in private ownership at prices more than the County or the State at present cares to pay.

The immediate neighborhood as yet is uninhabited except by the birds, but their squatter's rights may be contested at any time. In fact their composure was seriously interrupted for a period of several months by a swarm of human beings flocking to the marsh to try their angling skill, or lack of it.

In November, 1937, news spread that gypsies camped nearby had discovered catfish in these murky waters. The gypsy touch made it a good story but there was no doubt about the fact that good-sized square-tailed catfish were there in large numbers, and people came from everywhere to fish for them. No record was kept of the quantity of fish taken, but Richard S. Croker made some notes on the number of cars that visited the slough and approximated the number of fishermen. For example, at 4:30 p.m. on the Sunday afternoon of May 22, 1938, he counted 74 cars, exclusive of nonfishing visitors, and estimated 220 fishermen. During the eight months from November, 1937, through June, 1938, almost any day or at any time of the day or night, a dozen or two cars could be counted from either Anaheim Road or Alternate U. S. Highway 101, both of which cross the marsh. By July of 1938, the number of catfish and fishermen began to dwindle and through the following August and September, only two or three cars at a time were to be seen, and often the occupants of these had given up trying for catfish and had turned to capturing fresh-water crayfish. The slough had been fished down if not out in a few months of intensive angling.

This story has one remarkable feature, the eagerness with which all sorts and conditions of people from far and near joined the gold rush when the exciting news spread through the region that catfish had been discovered in Bixby Slough. People do like to fish.

Since the catfish are not native sons, obviously they were planted in Bixby Slough, but the how, when and why are not known. Many conflicting stories of intentional planting and accidental liberation went the rounds but all the facts have not come to light. However the plant was made, it certainly furnished recreation and thrills to several thousands of people, while the fish lasted. After seeing so many anglers flock to one small marsh, it is not so difficult to understand what happens to the trout in the streams of the southern part of the State. Yet, this one muddy slough gave outdoor sport to many people. We can't help speculating about other marshes where catfish might thrive and the reservoirs that are closed to anglers. If they were opened they might help to relieve the fishing pressure, or would they? Maybe they

would just attract additional fishermen because people do like to fish, but there are worse things they could be doing.—*W. L. Scofield, California State Fisheries Laboratory, September, 1938.*

## STRIPED BASS AT OCEANSIDE, SOUTHERN CALIFORNIA

On May 30, 1938, Mr. Bodenhammer of Inglewood was surf fishing at Oceanside, San Diego County, using mussels for bait. He hooked a fish that gave him a real battle and when landed it proved to be a striped bass weighing between 30 and 31 pounds.

The trophy was photographed and there could be no doubt about it being the picture of a striped bass (*Roccus lineatus*). Many reported catches of small striped bass in southern California (particularly at Oceanside) have upon investigation turned out to be big-eyed bass (*Xenistius californiensis*) of the family Lutianidae. Size alone would preclude the possibility of Mr. Bodenhammer's fish being the big-eyed bass, which does not exceed a foot in length. The eye diameter in relation to head length was about one-fifth or one-sixth, which is a characteristic of the striper, whereas the big-eyed bass has an eye diameter of about one-third the head length. The horizontal stripes of the big-eyed bass are an orange-brown but in stripers they are blackish.

There are several authentic records of true stripers being caught in Newport Bay, Orange County, possibly as the result of planting by the Division of Fish and Game of California. There is a record (*California Fish and Game, vol. 5, p. 197, 1919*) of several small striped bass caught in June, 1919, in San Diego River near its outlet into Mission Bay, at which spot the Fish and Game Commission had made a plant of 1800 small striped bass on October 26, 1916.—*W. L. Scofield, California State Fisheries Laboratory, September, 1938.*

## ARRIVAL OF BLACK SEA BRANT IN LOWER CALIFORNIA IN 1938

During a recent fisheries investigation cruise of the Division of Fish and Game motor vessel *Bluefin* along the Lower California coast during the period October 20 to November 18, 1938, we had the opportunity of noting the arrival of black brant (*Branta bernicla nigricans*) at San Quentín Bay and Cerros Island, Lower California. Cruising southward from San Diego, we stopped at San Quentín Bay on October 24th and entered the lagoon, but saw no brant at this time. We continued southward to Santa Rosalia Bay and then set westward for Cerros Island. On the morning of October 29th, we were working with a dinghy, outboard motor and net skiff, about four miles south of the cannery, which is situated on the east side and near the south end of the island, when we sighted seven black sea brant resting on the water, not far from shore. Since there is little attraction for the brant in the way of lagoons or eel grass around Cerros Island, the chances are that these few birds were resting preparatory to continuing southward. We went on to Magdalena and Almejas bays, passing up Scammon and San Ignacio lagoons. We spent several days at Magdalena but saw no brant there. However, we did not go up any of the lagoons where possibly we might have seen brant. On the return trip, we stopped at Turtle Bay

on November 14th. Although we scouted all parts of the bay we saw no brant. Continuing northward, we again stopped at San Quentín Bay. On the morning of November 17th, we entered the lagoon, and where we had seen no brant three weeks previous, we now saw several hundred. We did not attempt an official count, nor did we go far up the lagoon on this trip. It is safe to say that there were 600 brant at the lower end of the lagoon. It is not improbable that the black sea brant commenced arriving at San Quentín Lagoon a few days after we departed from there on October 24th. Possibly the few brant we saw at Cerros Island on October 29th were part of a flock that continued on past San Quentín. At any rate, black sea brant were found as far south as Cerros Island, Lower California, as early as October 29th, in 1938.—*J. B. Phillips, California State Fisheries Laboratory, November, 1938.*

# REVIEWS

## A NEW BULLETIN ON THE MACKEREL FISHERY

Fish Bulletin 52, recently issued by the Bureau of Marine Fisheries, is "Historical Account of the Los Angeles Mackerel Fishery," by Richard S. Croker of the California State Fisheries Laboratory. The mackerel fishery in California supplied small quantities to our local fresh fish markets for many years, but in 1928 when the canning of this species became general the fishery jumped to a position of major importance, exceeded in volume of the catch only by the sardine fishery. In the ten-year period since 1928 the fishery has undergone many interesting changes, and Fish Bulletin 52 is a detailed record of those changes during the development of the fishery. Special emphasis is given to recording the proportion of the total catch that has been delivered by the different types of fishing boats, using many kinds of fishing gear during the various stages in the growth of this fishery. This analysis of the catch is limited to the Los Angeles region but most of the mackerel catch of the western coast of the United States is made near and delivered to ports in the immediate neighborhood of Los Angeles.

The fresh fish markets are supplied with mackerel from the catches of small boats using hand lines, set lines and pole lines, while the canneries depend upon the catches of ring nets, purse seines and lamparas, although deliveries to canneries are made also by small boats employing hook and line or dip nets. Our mackerel fishery, then, employs most of the different kinds of fishing gear used on the west coast and the boats engaged vary from small skiffs to the large seagoing purse seine vessels. It is certainly a most varied and interesting fishery and one that seems to be in a constant state of change, so that this bulletin contributes a valuable service in recording the details of the changes taking place. This record will be useful when individual boat catches are analyzed for the purpose of showing variations that have occurred in our supply of mackerel. The bulletin is generously supplied with photographs, tables and graphs. The text gives some general account of the fishery, but concerns itself chiefly with a breakdown of the total catch into the amounts contributed by each of the several types of fishing gear and boats employed.

Fish Bulletin 52 may be considered a sequel to Fish Bulletin 40, "The California Mackerel Fishery," by the same author, issued in 1933. The earlier bulletin gave a general account of the fishery in different regions with descriptions of the growth and importance of the industry, fishing methods, canning practice, marketing problems, and the growing sport catch by marine anglers. The two bulletins between them give a most comprehensive survey of this spectacular fishery.—*W. L. Scofield, California State Fisheries Laboratory.*

## STANFORD ICHTHYOLOGICAL BULLETIN

It is a pleasure to record a new series of publications on fish, the Stanford Ichthyological Bulletin, published by Stanford University, under the editorship of George S. Myers, Professor of Biology and Head Curator of Zoological Collections at the university. Since the days of its first president, David Starr Jordan, Stanford has been noted for its leadership in research on fish and fisheries problems, and the appearance of the new series of bulletins is another manifestation of this leadership.

In his foreword to the first bulletin, Dr. Myers explains the aims of the series in these words, "In content it is expected that the Bulletin will be largely taxonomic or morphological, but it is intended that papers dealing with fisheries biology shall be published, and the widest latitude in subject matter having to do with fishes will be allowed. However, certain definite standards and limitations have, of necessity, been set up, due primarily to smallness of available funds. In taxonomy, the chief need of the present day is the clarification of relationships and the integration of previous work. For this reason, the editor feels that carefully done systematic revisions, phylogenetic studies, and attempts to correlate scattered work on classification should be given precedence over mere lists or reports on collections. Descriptions of new forms are important, and will be included, since each discovery provides an integral part of our picture of phylogeny, but such descriptions will in all cases be accompanied by adequate discussions of relationships, and wherever possible, by partial or complete revisions of related species or genera. In morphological, physiological, ecological, or other studies, papers contributing to the great central problems of the evolution, adaptation, and dispersal of fishes will receive first consideration, while in zoogeography faunal lists will give way to adequate discussions of the relationships and history of faunas. * * * The bulletin will appear irregularly, as material comes to hand. Volumes will be closed and indices provided when a sufficient number of pages has appeared."

The bulletin is attractively reproduced by means of photolithography and contains many excellent illustrations.

The first number of volume 1 made its appearance on June 22, 1938. It consists of a revision of the West Indian herrings by Margaret Storey. This paper, "West Indian clupeid fishes of the genus *Harengula*," is a complete study of the relationships of the herrings of the region, which are so closely related as to have caused confusion ever since the first species were described by the early explorers. Miss Storey examined thousands of specimens, subjecting them to statistical analysis, and also reviewed the voluminous literature on the genus. The result is something rare in ichthyological research—a finished piece of work, the genus and its several species completely defined. The text is accompanied by keys, good illustrations and an extensive bibliography. There is also a discussion of a closely related species of *Harengula* from the Pacific Coast.

Volume 1, number 2, appeared on July 20, 1938. It contains the descriptions of three new species of gobies. Isaac Ginsburg describes

two gobies from Lower California, and Albert W. C. T. Herre describes a new genus and species of eleotrid fish from Luzon.

Inquiries regarding the Bulletin should be addressed to: Editor, Stanford Ichthyological Bulletin, Stanford University, California.—*Richard S. Croker, Editor, California Fish and Game.*

**Field Book of Fresh-Water Fishes of North America North of Mexico**

By Ray Schrenkeisen; edited by J. T. Nichols and Francesca R. La Monte. New York, G. P. Putnam's Sons, 1938. 312 pp., illus. $3.50.

This field book, the latest in the Putnam series of nature field books, was prepared by the late Ray Schrenkeisen, Associate Editor of *Field and Stream*, but his death occurred before the material was ready for publication. His friends, Mr. Nichols and Miss La Monte of the American Museum of Natural History, took over the task of preparing the manuscript in its final form.

The result of the work of these three is gratifying. The field book will serve a useful purpose in aiding the sportsman and the beginning ichthyologist to identify the fresh-water fishes of America. Although there are no keys, the line drawings and concise descriptions serve to distinguish most of the species found in the United States and Canada. Particularly useful are the lists of scientific and vernacular names that have been applied at one time or another and in various localities to each fish. The fishes are discussed family by family, beginning with the most primitive. A glossary of technical terms and an index accompany the text.

It is surprising that so much worth-while information on such a wide and difficult field can be compressed into such a small volume. It is natural that some errors should creep in, and a faultfinder would no doubt have a merry time quibbling over nomenclature and distributions, although the editors themselves say, "* * * we have purposely avoided rulings on matters of classification or nomenclature, many of which are still unsettled." However, the book stands as the first real effort to provide a comprehensive treatment of the subject and is a long step in the right direction. The limitation of space precluded a fuller discussion of far western fishes and on the distribution of introduced species in the West, which was something of a disappointment.—*Richard S. Croker, Editor, California Fish and Game.*

**The Snakes of San Diego County**

By C. B. Perkins. Zoological Society of San Diego, California. Bulletin, no. 13, 66 pp., 41 figs., September, 1938. $0.50.

The bulletin is exactly what it purports to be, an account of "The snakes of San Diego County with descriptions and key." In understandable language, Mr. Perkins describes the various kinds of snakes found in the county and tells how to distinguish one from another. Identification is simplified by splendid illustrations and a well-constructed key. The descriptions of individual species include notes on habitat, range, food and life-history.

As San Diego County is the home of large numbers of five varieties of rattlesnakes, it is only natural that considerable space is devoted to these poisonous reptiles. The author speaks from long experience when he comments on the habits of rattlers and how to avoid danger from them, both before and after being bitten.

Mr. Perkins has given us a paper that should do much to help man feel friendlier toward snakes, most of which are distinctly beneficial. This bulletin is recommended to all students of wildlife and should be in every school library in southern California.—*Richard S. Croker, Editor, California Fish and Game.*

# IN MEMORIAM

## SAMUEL H. LYONS

In the death of Assistant Chief Samuel H. Lyons on September 26, 1938, from pneumonia contracted during a field inspection trip, the Bureau of Patrol and Law Enforcement has lost one of its most capable men.

Sam Lyons was born in Ballard, Santa Barbara County, February 2, 1889, and spent his boyhood in the beautiful Santa Ynez Valley. He went to work for the Fish and Game Commission as a game warden on July 15, 1927, with headquarters at Solvang. On October 1, 1928, he was promoted to Patrol Captain in charge of Santa Barbara and San Luis Obispo counties, transferring to Sacramento in April, 1930, where he was in charge of patrol activities in that vicinity. He was promoted to the position of Supervisor of Fisheries Patrol and Fish Cannery Inspection on August 1, 1931, with headquarters at Terminal Island, and given entire supervision of the Commercial Fisheries patrol from San Diego to Monterey. Another promotion followed on July 1, 1935, when he was transferred to Sacramento again, with the rank of Assistant Chief of Patrol in charge of the Central District, extending from Modoc and Siskiyou counties on the north to and including Kern County on the south.

Sam Lyons was a graduate in law from the University of Southern California and was a practicing attorney before he joined the Fish and Game Commission. His legal experience was most valuable in the complicated work of game law enforcement.

His unfailing cheerfulness and quiet efficiency gained the respect of all who came in contact with him, and to his widow and three children we express our sympathies.—*E. L. Macaulay, Chief of Patrol.*

## JAMES H. GROVES

Warden J. H. Groves passed away at Cloverdale on October 2, 1938. Mr. Groves, known affectionately as Harley to his fellow workers, was born on November 13, 1870, and entered the service on August 1, 1918, with headquarters at Cloverdale. In the twenty years he was with us, Harley Groves performed his work most efficiently and gained the respect and affection of sportsmen in his vicinity. He leaves a widow and children to whom we wish to express our sympathy.—*E. L. Macaulay, Chief of Patrol.*

## GEORGE E. WEST

It is with deep regret that we write of the death on November 18, 1938, of George E. West, one of the pioneers in the California Division of Fish and Game.

Mr. West was born on October 6, 1882. He was first employed by the Fish and Game Commission at its Brookdale fish hatchery in Santa Cruz County in April, 1908. In 1916, he was promoted to the position of Fish Hatchery Foreman and was transferred to the Lake Tahoe district, where he served for a number of years as foreman of the Tahoe Hatchery during the spring and summer months, working at Mt. Shasta Hatchery in the fall and winter. When the Tahoe Hatchery was made a year round station in 1926, he was placed in full charge. In September, 1933, Mr. West was transferred to Mendocino County where he supervised the work of the Cold Creek Hatchery, near Ukiah, in the capacity of foreman. Here he remained until the winter of 1937, at which time the hatchery was destroyed by floods. Since that time he was stationed in the same district. Early in 1938, Mr. West's health began to fail.

He will be missed by his many friends and coworkers in the Division of Fish and Game. To his wife and three children, we wish to extend our heartfelt sympathy in their loss.—*J. H. Vogt, Assistant Chief, Bureau of Fish Conservation.*

# REPORTS

## STATEMENT OF REVENUE

**For the Period July 1, 1938, to September 30, 1938, of the Ninetieth Fiscal Year**

REVENUE FOR FISH AND GAME PRESERVATION FUND

| | Detail | Total |
|---|---|---|
| Current year— | | |
| Licenses: | | |
| Angling, 1938 | $223,292 00 | |
| Angling, 1937 | 803 50 | |
| Commercial hunting club licenses, 1937-38 | 125 00 | |
| Commercial hunting club operators' licenses, 1937-38 | 45 00 | |
| Deer tags, 1938 | 35,036 00 | |
| Deer tags, 1937 | 468 32 | |
| Fish breeders', 1938 | 5 00 | |
| Fish packers' and wholesale shellfish dealers', 1938 | 765 00 | |
| Fishing party boat permits, 1938 | 162 00 | |
| Fish tags | 1,162 50 | |
| Game tags | 114 90 | |
| Game breeders', 1938 | 90 00 | |
| Hunting, 1938-39 | 98,278 50 | |
| Hunting, 1937-38 | 7,625 00 | |
| Market fishermen, 1938-39 | 37,250 00 | |
| Trapping, 1938-39 | 31 00 | |
| Trapping, 1937-38 | —77 00 | |
| Total licenses | | $405,170 78 |
| Other revenue: | | |
| Court fines | $8,849 40 | |
| Fish packers' tax | 39,400 01 | |
| Kelp tax | 114 68 | |
| Miscellaneous sales | 215 00 | |
| Publication sales | 7 50 | |
| Salmon packers' tax | 5,798 11 | |
| Cancelled warrant, Ch. 815-35 | 1 00 | |
| Total other revenue | | 54,385 70 |
| Total current year | | $459,562 48 |
| Prior year, 89th fiscal year: | | |
| Court fines | —$225 00 | —225 00 |
| Grand total | | $459,337 48 |

## STATEMENT OF EXPENDITURES

**For the Period July 1, 1938, to September 30, 1938, of the Ninetieth Fiscal Year**

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| **Operating Expenditures—90th Fiscal Year** | | | | | |
| Administration: | | | | | |
| Accident and death claims | | | | | $150 00 |
| Cashier | $450 00 | | | | 2,304 13 |
| Executive | 1,249 98 | $3 00 | $1,051 15 | | 1,250 00 |
| Exhibits | | | 1,250 00 | | 5,601 23 |
| General office | 1,830 00 | 185 51 | 3,576 97 | $8 75 | 525 42 |
| Library | 480 00 | 2 82 | 24 50 | 18 10 | 620 08 |
| Property inspection | 510 00 | 3 34 | 101 50 | 5 24 | 64 78 |
| Publicity | | | 64 78 | | |
| Total Administration | $4,519 98 | $194 67 | $6,068 90 | $32 09 | $10,815 64 |
| Patrol and Law Enforcement: | | | | | |
| Cannery inspection | $2,001 18 | | $182 70 | | $2,183 88 |
| Executive | 3,029 85 | $160 48 | 424 35 | | 3,614 68 |
| General office | 1,500 00 | 21 60 | 116 68 | $72 83 | 1,711 11 |
| Junior patrol | 740 00 | 2 18 | 175 85 | | 918 03 |
| Land patrol | 54,658 68 | 1,645 30 | 13,199 98 | 6,506 37 | 76,010 33 |
| Marine patrol | 17,504 15 | 2,726 78 | 8,569 48 | 1,832 67 | 30,633 08 |
| Pollution patrol | 2,660 00 | 123 84 | 981 95 | | 3,765 79 |
| Total Patrol and Law Enforcement | $82,093 86 | $4,680 18 | $23,050 99 | $8,411 87 | $118,836 90 |
| Marine Fisheries: | | | | | |
| Executive | $1,905 00 | $1 50 | $64 20 | | $1,970 70 |
| Field supervision | 825 00 | | 232 55 | | 1,057 55 |
| Fish cannery auditing | | | 555 60 | | 555 60 |
| General office | 2,369 19 | | 177 56 | | 2,546 75 |
| Research and statistics | 12,597 58 | 987 06 | 9,846 31 | $1,134 38 | 24,565 33 |
| Total Marine Fisheries | $17,696 77 | $988 56 | $10,876 22 | $1,134 38 | $30,695 93 |
| Fish Conservation: | | | | | |
| Biological survey | $2,820 00 | $74 75 | $569 96 | $5 96 | $3,470 67 |
| Executive | 1,740 00 | 1 50 | 67 70 | | 1,809 20 |
| Field supervision | 1,380 00 | 67 33 | 507 69 | 135 69 | 2,090 71 |
| Fish planting | 1,400 66 | 366 72 | 2,016 45 | 4 71 | 3,788 54 |
| Fish rescue | 3,771 20 | 85 91 | 1,213 36 | | 5,070 47 |
| General office | 1,290 00 | 10 84 | 2 61 | | 1,312 45 |
| Pollution inspection | 1,125 00 | 43 22 | 175 29 | | 1,343 51 |
| Stream improvements | | 79 95 | | 1 82 | 81 77 |
| Statistical | 590 00 | 80 20 | 251 86 | | 922 06 |
| Structural maintenance | 748 39 | 10 00 | 351 61 | | 1,110 00 |
| Alpine Hatchery | 919 84 | 149 35 | 43 20 | | 1,112 39 |
| Basin Creek Hatchery | 1,459 52 | 761 66 | 145 55 | | 2,366 73 |
| Benbow Dam Exp. Station | 93 33 | | 26 10 | | 119 43 |
| Big Creek Hatchery | 930 00 | 786 22 | 30 26 | 233 01 | 1,979 49 |
| Blackwood | 10 00 | | | | 10 00 |
| Blue Lakes Egg Col. Sta. | 285 00 | 4 30 | | | 289 30 |
| Brookdale Hatchery | 935 49 | 367 04 | 67 68 | 5 70 | 1,375 91 |
| Burney Creek Hatchery | 1,380 97 | 225 71 | 74 00 | | 1,680 68 |
| Carmen Lake Egg. Col. Sta. | | | 7 28 | | 7 28 |
| Central Valleys Hatchery | 937 50 | 493 48 | 380 98 | | 1,811 96 |
| Cold Creek Hatchery | | 13 19 | | | 13 19 |
| Cottonwood Lakes Egg Col. Station | 230 49 | 23 45 | 102 00 | | 355 94 |
| Fall Creek Egg. Col. Sta. | 1,210 00 | 540 30 | | | 1,750 30 |
| Fall Creek Hatchery | 616 29 | 348 57 | 82 90 | 87 08 | 1,134 84 |
| Feather River Hatchery | 1,282 74 | 642 39 | 71 65 | 5 35 | 2,002 13 |
| Fern Creek Hatchery | 530 00 | 21 95 | 2 50 | | 554 45 |
| Forest Home Hatchery | 2,246 16 | 43 30 | 387 47 | | 2,676 93 |
| Fort Seward Hatchery | 1,457 58 | 776 05 | 244 74 | 74 35 | 2,552 72 |
| Hot Creek Hatchery | 949 19 | 682 37 | 79 22 | 14 44 | 1,725 22 |
| Huntington Lake | 1,380 00 | 299 73 | 192 20 | 26 75 | 1,898 68 |
| Hobart Creek Egg Col. Sta | | 6 70 | | | 6 70 |
| Kaweah Hatchery | 1,183 06 | 291 90 | 411 10 | | 1,886 06 |
| Kings River Hatchery | 275 00 | 91 95 | | | 366 95 |
| Klamathon Egg Col. Sta. | 464 52 | 180 23 | 58 82 | | 703 57 |
| Lake Almanor Hatchery | 1,733 06 | 752 72 | 181 78 | | 2,667 56 |
| Madera Hatchery | 849 00 | 567 43 | 80 39 | 9 18 | 1,506 00 |
| Marlette Lake Egg Col. Station | 142 00 | | | | 142 00 |
| Mt. Shasta Exp. Hatchery | 450 00 | 191 12 | 4 00 | | 645 12 |
| Mount Shasta Hatchery | 10,178 75 | 6,745 15 | 1,636 58 | 206 38 | 18,766 86 |
| Mount Tallac Hatchery | 770 33 | 676 21 | 15 25 | 70 51 | 1,532 30 |
| Mount Whitney Hatchery | 4,045 38 | 1,564 28 | 537 09 | | 6,146 75 |
| Prairie Creek Hatchery | 1,705 00 | 916 48 | 275 64 | | 2,897 12 |

## STATEMENT OF EXPENDITURES

For the Period July 1, 1938, to September 30, 1938, of the Ninetieth Fiscal Year—Continued

| Function | Salaries and wages | Materials and supplies | Service and expense | Property and equipment | Total |
|---|---|---|---|---|---|
| Fish Conservation—Continued | | | | | |
| Scott Creek Egg Col. Station | $405 00 | $285 82 | $17 54 | | $708 36 |
| Shasta River Exp. Sta. | | | 75 00 | | 75 00 |
| Shasta River Egg Col. Station | 201 29 | 33 01 | | | 234 30 |
| Snow Mountain Egg Col. Station | 771 94 | 45 20 | 13 94 | | 831 08 |
| Tahoe Hatchery | 1,725 00 | 656 55 | 71 04 | $10 52 | 2,463 11 |
| Waddell Creek Station | 330 00 | 1 23 | 2 96 | | 334 19 |
| Yosemite Hatchery | 1,015 16 | 245 16 | 55 51 | 40 10 | 1,355 93 |
| Yuba River Hatchery | 903 55 | 283 80 | 101 85 | | 1,289 20 |
| Total Fish Conservation | $58,867 39 | $20,543 42 | $10,632 75 | $931 55 | $90,975 11 |
| Hydraulics: | | | | | |
| Engineering | $1,590 00 | $100 82 | $541 86 | | $2,238 68 |
| Executive | 1,020 00 | 29 56 | 220 08 | | 1,269 64 |
| Fish screens | | 370 46 | | $17 30 | 387 76 |
| General office | 510 00 | 3 09 | 39 78 | | 552 87 |
| Total hydraulics | $3,120 00 | $509 93 | $801 72 | $17 30 | $4,448 95 |
| Game Conservation: | | | | | |
| Elk Refuge | $760 00 | | $65 79 | $508 64 | $1,334 43 |
| Executive | 3,420 00 | $46 67 | 495 19 | | 3,961 86 |
| Game bird distribution, Los Serranos | 1,290 00 | 22 71 | 196 35 | | 1,509 06 |
| Game bird distribution, Yountville | 1,300 00 | 2,079 00 | 243 10 | | 3,622 10 |
| General office | 1,017 00 | 28 99 | 5 89 | 113 05 | 1,164 93 |
| Grey Lodge Refuge | 680 00 | 269 90 | 55 72 | | 1,005 62 |
| Imperial Refuge | 568 39 | 9 33 | 14 95 | | 592 67 |
| Los Banos Refuge | 900 65 | 121 53 | 55 29 | 3,047 75 | 4,125 22 |
| Los Serranos Game Farm | 3,519 77 | 208 37 | 1,154 51 | 89 73 | 4,972 38 |
| Los Serranos Boarding House | 192 00 | 478 63 | 13 41 | | 684 04 |
| Predatory animal lion hunting | 1,390 00 | 40 48 | 1,138 51 | 3 33 | 2,572 32 |
| Predatory animal trapping | 7,333 10 | 659 89 | 2,129 84 | 13 48 | 10,136 31 |
| Research | 300 00 | 49 88 | 144 58 | | 494 46 |
| Statistics | 585 00 | | 212 23 | | 797 23 |
| Suisun Refuge | 750 00 | 56 85 | 136 15 | 37 86 | 980 86 |
| Yountville Game Farm | 3,754 96 | $90 66 | 472 41 | 15 21 | 5,133 24 |
| Yountville Boarding House | 329 70 | 499 25 | 9 45 | | $38 40 |
| Total Game Conservation | $28,090 57 | $5,462 14 | $6,543 37 | $3,829 05 | $43,925 13 |
| Licenses: | | | | | |
| Executive | $870 00 | $14 20 | $64 60 | | $948 80 |
| General office | 360 00 | 27 65 | 61 09 | $158 47 | 607 21 |
| License distribution | 2,843 55 | 2,778 17 | 10,708 51 | 426 53 | 16,756 76 |
| Total licenses | $4,073 55 | $2,820 02 | $10,834 20 | $585 00 | $18,312 77 |
| Special Items: | | | | | |
| Construction of fish screens | $3,580 56 | $727 59 | $92 60 | $170 44 | $4,571 19 |
| Construction of research boat | 750 00 | | | 2,306 72 | 3,056 72 |
| Total Special Items | $4,330 56 | $727 59 | $92 60 | $2,477 16 | $7,627 91 |
| Total 90th fiscal year expenses paid from support appropriations | | | | | $325,638 34 |
| Prior year: | | | | | |
| 89th fiscal year for support | | | | | 98,225 69 |
| Total 89th and 90th fiscal year for support | | | | | $423,864 03 |
| Expenditures for Additions and Betterments: | | | | | |
| Permanent Improvements: | | | | | |
| Purchase of game refuges and public shooting grounds and C. I. E. Chap. 157-37, 90th fiscal year | $1,036 40 | $3,916 18 | $383 98 | $217 54 | $5,554 10 |
| Contributions to Employees' Retirement System | | | | | 5,045 03 |
| Total current biennium | | | | | $434,463 16 |

## SEIZURES OF FISH AND GAME

**July, August, September, 1938**

| | |
|---|---|
| Game: | |
| Deer | 14 |
| Deer hides | 2 |
| Deer meat, lbs. | 3,708 |
| Doves | 308 |
| Ducks, mallard | 26 |
| Geese, Canada | 6 |
| Grouse | 5 |
| Killdeer | 1 |
| Meadowlark | 2 |
| Mudhens | 4 |
| Pheasants | 41 |
| Pigeon | 1 |
| Band-tailed | 1 |
| Quail | 31 |
| Rabbits | |
| Brush | 16 |
| Cottontail | 17 |
| Jack | 3 |
| Sagehen | 1 |
| Wood duck | 1 |
| Wood ibis | 2 |
| Fish: | |
| Abalones, red | 101 |
| Barracuda, lbs. | 69 |
| Bass | |
| Black | 22 |
| Large-mouthed black | 7 |
| Striped | 82 |
| Striped, lbs. | 75 |
| Bass nets | 2 |
| Carp | 1 |
| Clams, Pismo | 728 |
| Crabs | 470 |
| Crab nets | 1 |
| Crappie | 10 |
| Crappie, lbs. | 1 |
| Kingfish, lbs. | 300 |
| Lobsters, lbs. | 170 |
| Lobster traps | 11 |
| Salmon, lbs. | 896 |
| Shad | 2 |
| Sunfish | 11 |
| Sunfish, lbs. | 1½ |
| Bluegill | 51 |
| Trout | 575 |
| Dolly Varden | 10 |
| Eastern brook | 120 |
| Golden | 143 |
| Loch Leven | 3 |
| Rainbow | 5 |
| Rainbow, lbs. | 20 |
| Steelhead | 22 |
| Tuna, bluefin | 3 |
| Yellowtail | 1,854 |

## GAME CASES

July, August, September, 1938

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Deer; possess deer meat closed season, take with spotlight, spike buck, allowing dogs to run deer, hides, evidence of sex removed, fail to fill out tag, take female deer, hunting deer at night, fail to retain hide and antlers in possession, possess spotted fawn, forked horn in Dist. 1¾ | 180 | $5,335 00 | 1,263½ |
| Doves; closed season, illegal shipment, shoot from auto | 69 | 1,640 00 | 35 |
| Ducks; closed season | 5 | 70 00 | 10 |
| Firearms; in game refuge | 14 | 240 00 | |
| Frogs; possession undersized | 1 | 25 00 | |
| Game; fail to show on demand, take with spotlight, possession gun and spotlight in game area | 8 | 210 00 | |
| Game birds; closed season | 6 | 80 00 | |
| Geese; closed season | 2 | 30 00 | |
| Grouse | 3 | 50 00 | |
| Hunting; no license, night hunting from auto | 35 | 495 00 | 125 |
| Killdeer; possession | 1 | 10 00 | |
| Mink; trapping for profit | 1 | 10 00 | |
| Pheasants | 32 | 1,090 00 | 20 |
| Pigeons; closed season, band-tailed closed season | 2 | 50 00 | |
| Quail; closed season | 14 | 340 00 | 50 |
| Rabbits; no license, cottontails, closed season, brush rabbits | 25 | 232 50 | 12½ |
| Robins; possession of | 1 | 10 00 | |
| Sagehen; closed season | 1 | 25 00 | |
| Seal; killing | 1 | | |
| Spotlighting | 4 | | |
| Shooting; in game refuge, from highway, from auto | 10 | 80 00 | |
| Trapping; no license, fail to send record to San Francisco office | 11 | 85 00 | |
| Wood ibis; possession | 1 | 50 00 | |
| Totals | 427 | $10,157 50 | 1,516 |

## FISH CASES

### July, August, September, 1938

| Offense | Number arrests | Fines imposed | Jail sentences (days) |
|---|---|---|---|
| Abalones; undersized, overlimit red | 28 | $175 00 | 5 |
| Angling; no license, closed season, fail to show license on demand, transfer license, too close to dam, less than 250 ft. from fish ladder, night, 2 poles and more than 2 attractors | 154 | 1,445 00 | 240 |
| Barracuda; no license, undersized | 4 | 40 00 | |
| Bass; undersized, no license, striped, no license, take young bass for bait, selling sea-bass, bass traps in Dist. 19 | 61 | $83 50 | 20 |
| Catfish; retaining in live box | 1 | | |
| Clams; closed season, out of shell, Pismo, no license, jackknife no license, undersized cockle clams | 35 | 625 00 | 37½ |
| Cockles; no license | 1 | 5 00 | |
| Commercial fishing; no license | 64 | 360 00 | |
| Corbina; selling | 2 | | |
| Crabs; undersize | 15 | 75 00 | 10 |
| Fail to deliver fish receipt records to San Francisco office | 1 | 10 00 | |
| Fish; take with shovel, take from State ponds | 3 | 50 00 | |
| Lobsters; closed season | 3 | | 45 |
| Mollusks; taking without commercial license, fail to show on demand | 3 | 65 00 | |
| Nets; destroy another's, using drag nets, drift gill nets in Dist. 15, gill net in Klamath River District, gill net in Smith River, fyke net no commercial license, operate net in Dist. 3 | 21 | 1,150 00 | |
| Operate party fishing boat without permit | 2 | 10 00 | |
| Pollution | 6 | 1,000 00 | |
| Reducing more than 32½% of sardines accepted for canning | 1 | 100 00 | |
| Set line; in Georgiana Slough, in Honker Bay | 7 | 485 00 | |
| Salmon; overlimit | 1 | 25 00 | |
| Seines; illegal use, purse seines in Dist. 20, operate beach seine in Dist. 2B | 66 | 4,140 00 | 210 |
| Spotfin croaker; no license | 2 | 10 00 | |
| Sunfish; no license, closed season | 16 | 135 00 | 22½ |
| Trout; using 2 poles, closed season, overlimit, take with set lines, bringing into State and failing to tag | 27 | 630 00 | |
| Waste of food fish | 2 | 50 00 | |
| Yellowfin croaker; no license | 2 | 7 00 | |
| Yellowtail; overlimit | 1 | 25 00 | |
| Totals | 529 | $11,800 50 | 590 |

## FRESH FISH LANDINGS OF CALIFORNIA BOATS

July, 1938

Compiled by the Division of Fish and Game, Bureau of Marine Fisheries

| Species | California waters | | | | | | | | Oregon waters | Waters south international boundary | | Total landings of California boats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Regions 10 and 20, Del Norte and Eureka | Region 30, Sacramento | Region 40, San Francisco | Region 50, Monterey | Region 60, Santa Barbara | Region 70, Los Angeles | Region 80, San Diego | Total pounds | Regions 10 and 20, Del Norte and Eureka | Region 70, Los Angeles | Region 80, San Diego | |
| Anchovy | | | 1,400 | 1,700 | | 150 | | 3,250 | | | | 3,250 |
| Barracuda | | | 322 | 169 | 952 | 174,951 | 123,173 | 299,076 | | | 728 | 299,804 |
| Cabezone | | | | | | | | 491 | | | | 491 |
| Catfish | | 3,462 | | | | | | 3,462 | | | | 3,462 |
| Cultus, Pacific | 63,216 | | 21,336 | 4,495 | 60 | 9 | | 89,116 | | | | 89,116 |
| Flounder, Starry | 173,833 | | 895 | 58 | 16 | | | 174,802 | | | | 174,802 |
| Flying Fish | | | | | | 5,495 | | 5,495 | | | | 5,495 |
| Grouper | | | | | | | | | | | 987 | 987 |
| Hake | 150 | | | | | | | 150 | | | | 150 |
| Halibut, California | 63 | | 859 | 8,463 | 28,395 | 8,426 | 1,417 | 47,623 | | | 19,837 | 67,460 |
| Halibut, Northern | 148,848 | | | | | | | 148,848 | | | | 148,848 |
| Kingfish | | | 84 | 10,699 | | 25,445 | | 36,228 | | | | 36,225 |
| Mackerel, Horse | | | | 9,259 | | 60,062 | 11,569 | 80,890 | | | | 80,890 |
| Mackerel, Pacific | | | | 70,181 | 48 | 2,771,995 | 398,497 | 3,240,721 | | | | 3,240,721 |
| Perch | | | 2,594 | 811 | 2,392 | 1,514 | 691 | 8,002 | | | | 8,002 |
| Pompano, California | | | | | | 63 | | 63 | | | | 63 |
| Ratfish | | | | | 260 | | | 260 | | | | 260 |
| Rock Bass | | | | | 1,912 | 17,975 | 19,562 | 39,449 | | 100 | 1,585 | 41,134 |
| Rockfish | 141,985 | | 43,181 | 148,585 | 8,908 | 24,102 | 5,014 | 371,775 | | | 7,658 | 379,433 |
| Sablefish | 23,764 | | 738 | 11,212 | | 2,216 | | 37,930 | | | | 37,930 |
| Salmon | 619,857 | | 48,348 | 16,850 | | | | 685,055 | 106 | | | 685,161 |
| Sand Dab | 38,924 | | 22,144 | 1,179 | | 340 | | 62,587 | | | | 62,587 |
| Sardine | | | 32,167 | 234,495 | 612 | 10,435 | 1,929 | 279,638 | | | | 279,638 |
| Sculpin | | | | | 25 | 9,501 | 1,205 | 10,731 | | | | 10,731 |
| Sea-bass, Black | | | | | 1,836 | 792 | 230 | 2,858 | | 40,260 | 12,864 | 55,982 |
| Sea-bass, White | | | | | 15 | 3,575 | 19,535 | 23,125 | | | 11,501 | 34,634 |
| Shark | 3,600 | 13,561 | 7,564 | 356,472 | 235,582 | 20,108 | 11,519 | 714,508 | | | | 714,508 |
| Sheepshead | | | | | 189 | 1,633 | | 1,822 | | | | 1,822 |
| Skate | 7,853 | | 4,950 | 3,948 | 3,700 | 112 | | 20,563 | | | | 20,563 |
| Smelt | 1,653 | | 13,481 | 12,584 | 2,511 | 8,629 | | 38,858 | | | | 38,858 |
| Sole | 568,088 | | 114,355 | 5,155 | 10,383 | 271 | | 698,252 | | | | 698,252 |
| Swordfish, Broadbill | | | | | 3,650 | 43,631 | 26,837 | 74,118 | | | 12,909 | 87,027 |
| Tomcod | 1,225 | | | | | | | 1,225 | | | | 1,225 |
| Tuna, Albacore | 15,877 | | | 718 | 1,811 | 590,518 | 124,866 | 733,790 | | | 5,100 | 738,890 |
| Tuna, Bluefin | | | | | | 6,250,174 | 900,119 | 7,168,293 | | | 465,421 | 7,633,714 |
| Tuna, Bonito | | | | | | 187,167 | 413,264 | 600,431 | | 544 | 12,588 | 613,563 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tuna, Skipjack | | | | | | 329 | 125 | 454 | | 1,753,724 | 3,283,961 | 5,037,685 |
| Tuna, Yellowfin | | | | | | | | 7,484 | | 4,403,935 | 9,124,428 | 13,528,817 |
| Turbot | | | 7,484 | | | | | 16,831 | | | | 7,484 |
| Whitebait | 16,080 | | 751 | | | | | 856 | | 60 | 903 | 16,831 |
| Whitefish, Ocean | | | | | 223 | 633 | | | | | | 1,819 |
| Yellowtail | | | | | | 12,893 | 33,961 | 46,854 | | 131,025 | 861,666 | 1,039,545 |
| Miscellaneous Fish | 11,915 | | 1,190 | 1,419 | 142 | 1,811 | | 16,477 | | | | 16,477 |
| Crustacean: | | | | | | | | | | | | |
| Crab | 143,774 | | 240,822 | 1,502 | | | | 395,098 | 24 | | | 395,122 |
| Shrimp | | | 453,248 | 395 | | | | 453,643 | | | | 453,643 |
| Mollusk: | | | | | | | | | | | | |
| Abalone | | | | 266,850 | 145,495 | | | 412,345 | | | | 412,345 |
| Clam, Cockle | | | 41 | | | 1,831 | | 1,872 | | | | 1,872 |
| Clam, Gaper | | | 474 | 220 | | | | 694 | | | | 694 |
| Clam, Pismo | | | | | 27,114 | | | 27,114 | | | | 27,114 |
| Clam, Soft-shell | 34 | | 5,963 | | | | | 5,997 | | | | 5,997 |
| Clam, Washington | | | 434 | | | | | 434 | | | | 434 |
| Octopus | 77 | | 1,551 | 4,229 | | | | 5,857 | | | | 5,857 |
| Oyster, Eastern | | | 13,592 | | | | | 13,592 | | | | 13,592 |
| Oyster, Japanese | | | 51,642 | | 1,528 | | | 53,170 | | | | 53,170 |
| Oyster, Native | | | 4,061 | | | | | 4,061 | | | | 4,061 |
| Squid | | | | 38,070 | | | | 38,070 | | | | 38,070 |
| Total pounds | 1,080,915 | 17,026 | 1,104,071 | 1,209,718 | 537,759 | 10,251,786 | 2,102,513 | 17,204,388 | 130 | 6,320,648 | 13,822,144 | 37,356,310 |

*The eight geographical regions of the State are as follows:
Regions 10 and 20, Del Norte and Eureka: Del Norte, Humboldt and Mendocino counties.
Region 30, Sacramento: Sacramento and San Joaquin river systems with the delta areas, including Suisun Bay and Lake County.
Region 40, San Francisco: Sonoma, Marin, San Francisco and San Mateo counties, including San Francisco and San Pablo bays.
Region 50, Monterey: Santa Cruz and Monterey counties.
Region 60, Santa Barbara: San Luis Obispo, Santa Barbara and Ventura counties.
Region 70, Los Angeles: Los Angeles and Orange counties.
Region 80, San Diego: San Diego and Imperial counties.

These tables are subject to slight revision due to belated supplemental items.

## FRESH FISH LANDINGS OF CALIFORNIA BOATS

August, 1938

Compiled by the Division of Fish and Game, Bureau of Marine Fisheries

| Species | California waters | | | | | | | | Oregon waters | Waters south international boundary | | Total landings of California boats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Regions 10 and 20, Del Norte and Eureka | Region 30, Sacramento | Region 40, San Francisco | Region 50, Monterey | Region 60, Santa Barbara | Region 70, Los Angeles | Region 80, San Diego | Total pounds | Regions 10 and 20, Del Norte and Eureka | Region 70, Los Angeles | Region 80, San Diego | |
| Anchovy | | | | 1,850 | | 16,905 | | 18,755 | | | | 18,755 |
| Barracuda | | | | | 84 | 134,392 | 55,591 | 190,067 | | 2,420 | 11,366 | 203,853 |
| Cabezone | | | | 73 | | | | 73 | | | | 73 |
| Carp | | 115 | | | | | | 115 | | | | 115 |
| Catfish | | 3,183 | | | | | | 3,183 | | | | 3,183 |
| Cultus, Pacific | 56,873 | | 6,584 | 3,642 | 22 | 18 | | 67,139 | 467 | | | 67,606 |
| Eel | | | | | | 18 | | 18 | | | | 18 |
| Flounder, Starry | 28,207 | | 16,285 | 50 | | | | 44,542 | 73 | | | 44,615 |
| Flying Fish | | | | | | 6,867 | | 6,867 | | | | 6,867 |
| Hake | 100 | | 2,210 | | | | | 2,310 | | | | 2,310 |
| Halibut, California | | | 184 | 9,998 | 39,723 | 11,721 | 6,633 | 68,259 | | | 57,082 | 125,341 |
| Halibut, Northern | 4,649 | | | 35 | | | | 4,684 | | | | 4,684 |
| Kingfish | | | 353 | 13,044 | 73 | 13,763 | 66 | 27,299 | | | | 27,299 |
| Mackerel, Horse | | | | 2,762 | | 156,780 | | 159,542 | | | | 159,542 |
| Mackerel, Pacific | | | | 676,152 | 13,013 | 20,648,166 | 763,515 | 22,101,446 | | | | 22,101,446 |
| Mullet | | | | | | 25 | 36 | 61 | | | | 61 |
| Perch | | | 3,656 | 360 | 3,995 | 3,850 | | 11,891 | | | | 11,891 |
| Pike | | 5 | | | | | | 5 | | | | 5 |
| Pompano, California | | | | | | 104 | 572 | 676 | | | | 676 |
| Ratfish | | | | 47 | 925 | | | 972 | | | | 972 |
| Rock Bass | | | | | 1,552 | 12,746 | 45,800 | 60,098 | | 80 | 894 | 61,072 |
| Rockfish | 21,830 | | 28,435 | 97,934 | 7,087 | 9,035 | 7,735 | 172,956 | | | 4,745 | 177,701 |
| Sablefish | 47,009 | | 1,038 | 4,532 | | 934 | | 53,513 | | | | 53,513 |
| Salmon | 387,721 | 160,778 | 2,897 | | | | | 551,396 | 25 | | | 551,421 |
| Sand Dab | 44,911 | | 24,760 | 5,522 | | 524 | | 75,717 | 525 | | | 76,242 |
| Sardine | | | 6,752,581 | 47,506,811 | | 33,592 | 2,766 | 54,295,750 | | | | 54,295,750 |
| Sculpin | | | | | 175 | 10,659 | 2,200 | 13,034 | | | | 13,034 |
| Sea-bass, Black | | | | | 535 | 3,165 | 401 | 4,101 | | 24,739 | 1,519 | 30,359 |
| Sea-bass, Short-fin | | | | | | | 80 | 80 | | | | 80 |
| Sea-bass, White | | | 568 | 49 | 183 | 12,835 | 2,761 | 16,396 | | 66 | 26,589 | 43,051 |
| Shark | 30,929 | 684,245 | 5,414 | 674,704 | 104,695 | 21,635 | 4,072 | 1,525,694 | | 85 | | 1,525,779 |
| Sheepshead | | | | | 44 | 1,951 | | 1,995 | | | | 1,995 |
| Skate | 8,557 | | 12,010 | 1,607 | 2,059 | 1,212 | | 25,445 | | | | 25,445 |
| Smelt | 1,885 | | 17,343 | 7,125 | 1,812 | 10,880 | | 39,045 | | | 65 | 39,090 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sole | 678,048 | | 145,202 | 18,984 | 13,366 | 78 | | 856,638 | 9,737 | | | 866,375 |
| Swordfish, Broadbill | | | | | 22,341 | 56,437 | 9,455 | 88,233 | | 22,754 | 205,807 | 316,794 |
| Tuna, Albacore | 87 | | 925 | 295,597 | 18,600 | 198,237 | 32,843 | 546,289 | | | 23,187 | 569,476 |
| Tuna, Bluefin | | | | | 9,647 | 1,201,942 | 186,726 | 4,398,315 | | 165,330 | 137,804 | 4,701,449 |
| Tuna, Bonito | | | | | 1,601 | 245,088 | 72,158 | 318,850 | | 1,373,668 | 78,227 | 1,770,745 |
| Tuna, Skipjack | | | | | | 27 | | 27 | | 1,576,957 | 1,530,021 | 3,107,005 |
| Tuna, Yellowfin | | | | | | 434 | 62 | 496 | | 3,540,063 | 5,505,531 | 9,046,090 |
| Turbot | | | 10,235 | | | | | 10,235 | | | | 10,235 |
| Whitebait | 1,816 | | | 45 | | | | 1,861 | | | | 1,861 |
| Whitefish, Ocean | | | | | 105 | 231 | 300 | 636 | | | 1,993 | 2,629 |
| Yellowtail | | | | | | 9,032 | 18,589 | 27,621 | | 1,759,473 | 1,647,911 | 3,435,005 |
| Miscellaneous Fish | 6,922 | | 1,370 | 225 | 369 | 30,916 | | 39,802 | 73 | | | 39,875 |
| Crustacean: | | | | | | | | | | | | |
| Crab | 134,580 | | 167,454 | 72 | | | | 302,106 | 1,792 | | | 303,898 |
| Shrimp | | | 340,074 | 312 | | | | 340,386 | | | | 340,386 |
| Mollusk: | | | | | | | | | | | | |
| Abalone | | | | 145,900 | 103,005 | 950 | | 249,855 | | | | 249,855 |
| Clam, Cockle | | | 40 | | | 851 | | 891 | | | | 891 |
| Clam, Gaper | | | 232 | 200 | | | | 432 | | | | 432 |
| Clam, Pismo | | | | | 23,761 | | | 23,761 | | | | 23,761 |
| Clam, Soft-shell | 39 | | 7,210 | | | | | 7,249 | | | | 7,249 |
| Clam, Washington | | | 388 | | | | | 388 | | | | 388 |
| Octopus | | | 648 | 2,501 | | | | 3,149 | | | | 3,149 |
| Oyster, Eastern | | | 12,812 | | | | | 12,812 | | | | 12,812 |
| Oyster, Japanese | | | 75,643 | | 2,052 | | | 77,695 | | | | 77,695 |
| Oyster, Native | | | 2,531 | | | | | 2,531 | | | | 2,531 |
| Squid | | | | 54,915 | | | | 54,915 | | | | 54,915 |
| Total pounds | 1,455,063 | 848,326 | 7,639,142 | 40,525,048 | 371,427 | 25,856,930 | 1,212,361 | 80,908,297 | 12,692 | 8,465,635 | 9,232,721 | 104,619,345 |

*The eight geographical regions of the State are as follows:
Regions 10 and 20, Del Norte and Eureka: Del Norte, Humboldt and Mendocino counties.
Region 30, Sacramento: Sacramento and San Joaquin river systems with the delta areas, including Suisun Bay and Lake County.
Region 40, San Francisco: Sonoma, Marin, San Francisco and San Mateo counties, including San Francisco and San Pablo bays.
Region 50, Monterey: Santa Cruz and Monterey counties.
Region 60, Santa Barbara: San Luis Obispo, Santa Barbara and Ventura counties.
Region 70, Los Angeles: Los Angeles and Orange counties.
Region 80, San Diego: San Diego and Imperial counties.
These tables are subject to slight revision due to belated supplemental items.

## FRESH FISH LANDINGS OF CALIFORNIA BOATS

### SEPTEMBER, 1938

Compiled by Division of Fish and Game, Bureau of Marine Fisheries

| Species | California waters | | | | | | | | Oregon waters | Waters south international boundary | | Total landings of California boats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Regions 10 and 20, Del Norte and Eureka | Region 30, Sacramento | Region 40, San Francisco | Region 50, Monterey | Region 60, Santa Barbara | Region 70, Los Angeles | Region 80, San Diego | Total pounds | Regions 10 and 20, Del Norte and Eureka | Region 70, Los Angeles | Region 80, San Diego | |
| Anchovy | | | 900 | 1,445 | | 32,693 | | 35,038 | | | | 35,038 |
| Barracuda | | | | | 6,671 | 43,739 | 24,639 | 75,049 | | 30,040 | 122,519 | 227,608 |
| Cabezone | | | | 159 | | | | 159 | | | | 159 |
| Carp | | 250 | | | | | | 250 | | | | 250 |
| Catfish | | 58,783 | | | | | | 58,783 | | | | 58,783 |
| Cultus, Pacific | 46,743 | | 5,202 | 2,154 | 23 | 41 | | 54,163 | 360 | | | 54,532 |
| Flounder, Starry | 22,698 | | 6,560 | 357 | 278 | | | 29,593 | 135 | | | 30,028 |
| Flying Fish | | | | | | 3,436 | | 3,436 | | | | 3,436 |
| Hake | 715 | | | | | | | 715 | | | | 715 |
| Halibut, California | | | 320 | 1,984 | 45,611 | 8,810 | 3,378 | 60,103 | | 351 | 75,969 | 136,426 |
| Halibut, Northern | 4,554 | | | | | | | 4,554 | | | | 4,554 |
| Kingfish | | | | 8,227 | 26 | 15,126 | 45 | 23,424 | | | | 23,424 |
| Mackerel, Horse | | | | 11,178 | | 249,973 | | 261,151 | | | | 261,151 |
| Mackerel, Pacific | | | | 206,588 | 3,533 | 11,150,357 | 319,380 | 11,679,858 | | | | 11,679,858 |
| Mackerel, Spanish | | | | | | | | | | | | |
| Perch | | | 1,738 | 245 | 465 | 890 | | 3,338 | | | 1,237 | 1,237 |
| Pike | | 58 | | | | | | 58 | | | | 3,338 |
| Pompano, California | | | | | | 6 | | 6 | | | | 58 |
| Rock Bass | | | | | 491 | 6,423 | 20,001 | 26,915 | | | 1,869 | 0 |
| Rockfish | 40,818 | | 10,268 | 31,917 | 1,828 | 7,449 | 3,306 | 95,586 | 524 | 470 | 9,591 | 28,784 |
| Sablefish | 56,625 | | 1,272 | 335 | | 535 | | 58,767 | | | | 106,177 |
| Salmon | 261,152 | 1,429,714 | 32,382 | | | | | 1,723,248 | | | | 58,767 |
| Sand Dab | 43,692 | | 12,343 | 595 | 7 | 387 | | 57,024 | | | | 1,723,248 |
| Sardine | | 14,814,600 | 60,303,524 | 57,716,202 | | 198,529 | 1,487 | 142,034,432 | | | | 57,024 |
| Sculpin | | | | | | 6,424 | 1,961 | 8,385 | | | | 142,034,432 |
| Sea-bass, Black | | | | | 1,921 | 1,012 | 1,460 | 4,393 | | 58,144 | 8,459 | 8,385 |
| Sea-bass, White | | | 7,517 | 16,323 | 29,468 | 26,803 | 4,002 | 84,203 | | 22,811 | 164,908 | 70,996 |
| Shark | 32,580 | 1,190,083 | 7,663 | 238,401 | 22,091 | 14,560 | 6,472 | 1,511,865 | 32 | 1,050 | | 271,922 |
| Sheepshead | | | | | | 2,868 | 936 | 3,804 | | | 1,412 | 1,512,947 |
| Skate | 8,068 | | 7,005 | 453 | 525 | 312 | | 16,363 | | | | 5,216 |
| Smelt | 1,563 | | 4,016 | 12,182 | 1,376 | 13,976 | 753 | 33,866 | | | 327 | 16,363 |
| Sole | 588,357 | | 112,205 | 5,248 | 24,095 | 189 | | 730,094 | 7,052 | | | 34,193 |
| Split-tail | | 1,153 | | | | | | 1,153 | | | | 737,146 |
| Sucker | | 10 | | | | | | 10 | | | | 1,153 |
| | | | | | | | | | | | | 10 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Swordfish, Broadbill | | | | | 47,985 | 44,173 | 1,058 | 94,116 | | 15,294 | 131,348 | 240,758 |
| Tomcod | 810 | | | | | | | 810 | | | | 810 |
| Tuna, Albacore | 6,306 | | 3,739 | 1,358,192 | 83,903 | 428,285 | 11,178 | 1,891,603 | | | 1,632 | 1,893,235 |
| Tuna, Bluefin | | | | | 173 | 1,761,639 | 278,226 | 2,039,438 | | 361,960 | 1,294 | 2,402,701 |
| Tuna, Bonito | | | | 11 | 158 | 1,068,059 | 157,456 | 1,225,984 | | 1,121,247 | 278,881 | 2,626,112 |
| Tuna, Skipjack | | | | | | | | | | 1,162,396 | 2,106,088 | 3,268,484 |
| Tuna, Yellowfin | | | | | | 2,663 | 5,619 | 8,282 | | 2,201,214 | 5,514,926 | 7,751,422 |
| Turbot | | | 5,609 | 700 | | | | 6,309 | | | | 6,309 |
| Whitefish, Ocean | | | | | | 140 | 163 | 303 | | | 2,246 | 2,549 |
| Yellowtail | | | | | | 11,211 | 20,251 | 34,492 | | 378,831 | 863,434 | 1,276,757 |
| Miscellaneous Fish | 12,453 | | 3,105 | 540 | 438 | 26,486 | | 43,022 | | 350 | 274 | 43,646 |
| Crustacean: | | | | | | | | | | | | |
| Crab | 6,972 | | | | | | | 6,972 | | | | 6,972 |
| Crab, Rock | | | | | | 1,068 | | 1,068 | | | | 1,068 |
| Shrimp | | | 214,054 | 38 | | | | 214,092 | | | | 214,092 |
| Mollusk: | | | | | | | | | | | | |
| Abalone | | | | 139,700 | 68,217 | 812 | | 208,729 | | | | 208,729 |
| Clam, Cockle | | | 15 | | | 3,101 | | 3,116 | | | | 3,116 |
| Clam, Gaper | | | 160 | | | | | 160 | | | | 160 |
| Clam, Pismo | | | | 4,794 | 16,752 | | | 21,546 | | | | 21,546 |
| Clam, Soft-shell | 78 | | 6,974 | | | | | 7,052 | | | | 7,052 |
| Clam, Washington | 2,257 | | 288 | | | | | 2,545 | | | | 2,545 |
| Octopus | | | 59 | 1,302 | | | | 1,361 | | | | 1,361 |
| Oyster, Eastern | 2,556 | | 20,602 | | | | | 23,158 | | | | 23,158 |
| Oyster, Japanese | | | 77,986 | | 2,140 | | | 80,126 | | | | 80,126 |
| Oyster, Native | | | 724 | | | | | 724 | | | | 724 |
| Squid | | | | 49,870 | | | | 49,870 | | | | 49,870 |
| Total pounds | 1,139,003 | 17,494,651 | 69,847,130 | 59,803,230 | 358,475 | 15,104,614 | 802,761 | t61,045,861 | 8,112 | 5,354,176 | 9,316,414 | 179,324,566 |

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Region 40, San Francisco: Sonoma, Marin, San Francisco and San Mateo counties, including San Francisco and San Pablo bays.
Region 50, Monterey: Santa Cruz and Monterey counties.
Region 60, Santa Barbara: San Luis Obispo, Santa Barbara and Ventura counties.
Region 70, Los Angeles: Los Angeles and Orange counties.
Region 80, San Diego: San Diego and Imperial counties.
These tables are subject to slight revision due to belated supplemental items.

## FRESH FISH IMPORTATIONS FROM OTHER STATES AND FOREIGN COUNTRIES*

### July, 1938

| | Oregon and Washington | Japan |
|---|---|---|
| For canneries: | | |
| Tuna, Albacore | 4,435 | 380,357 |
| Tuna, Skipjack | | 121,822 |
| Total pounds | 4,435 | 508,179 |

### August, 1938

| | Oregon and Washington | Japan |
|---|---|---|
| For canneries: | | |
| Tuna, Albacore | 4,038,481 | 299,022 |
| Tuna, Skipjack | | 74,188 |
| Tuna, Yellowfin | | 24,937 |
| Total pounds | 4,038,481 | 398,147 |

### September, 1938

| | Oregon and Washington | Japan |
|---|---|---|
| For canneries: | | |
| Tuna, Albacore | 525,686 | |
| Total pounds | 525,686 | |

*Figures for importations of albacore from Oregon and Washington include fish caught by a few California boats temporarily operating and landing their catches in those states.

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## BUREAU OF HYDRAULICS

JOHN SPENCER, Chief ..... San Francisco
Clarence Elliger, Assistant Hydraulic Engineer ..... San Francisco
Byron Wittorff, Assistant ..... San Francisco

## BUREAU OF LICENSES

H. R. DUNBAR, Chief ..... Sacramento
J. J. Shannon, License Agent ..... Sacramento
L. O'Leary, License Agent ..... San Francisco
R. Nickerson, License Agent ..... Los Angeles

# BUREAU OF PATROL

E. L. MACAULAY, Chief of Patrol ..... San Francisco

## CENTRAL DISTRICT (Headquarters, Sacramento)

———, Inspector in Charge ..... Sacramento

### Northern Division

Jos. H. Sanders, Captain in Charge ..... Sacramento
Don Chipman, Warden, Flying Squad ..... Dunsmuir
Wm. La Marr, Warden, Flying Squad ..... Nevada City
Eugene Durney, Assistant Warden, Flying Squad ..... Sacramento
A. H. Willard, Captain ..... Nevada City
A. A. Jordan, Captain ..... Redding
Chas. Sibeck, Warden, Launch *Perch* ..... Sacramento
L. M. Booth, Assistant Warden, Launch *Perch* ..... Sacramento
E. J. Johnson, Warden, Butte County ..... Gridley
L. E. Mercer, Warden, Butte County ..... Chico
Taylor London, Warden, Colusa County ..... Colusa
Albert Sears, Warden, El Dorado County ..... Placerville
E. C. Vail, Warden, Glenn County ..... Willows
C. O. Fisher, Warden, Lassen County ..... Susanville
Don Davison, Warden, Modoc County ..... Alturas
Earl Hiscox, Warden, Nevada County ..... Nevada City
Nelson Poole, Warden, Placer County ..... Auburn
W. C. Blewett, Warden, Plumas County ..... Quincy
J. E. Hughes, Warden, Sacramento County ..... Sacramento
H. S. Vary, Warden, Sacramento County ..... Sacramento
Earl Caldwell, Warden, Shasta County ..... Burney
Chas. Love, Warden, Shasta County ..... Redding
A. Granstrom, Warden, Sierra County ..... Downieville
Brice Hammack, Warden, Siskiyou County ..... Yreka
Fred R. Starr, Warden, Siskiyou County ..... Dorris
W. J. Black, Warden, Solano County ..... Suisun
L. W. Dinsdale, Warden, Sutter County ..... Yuba City
R. W. Anderson, Warden, Tehama County ..... Red Bluff
C. L. Gourley, Warden, Trinity County ..... Weaverville
R. L. Sinkey, Warden, Yolo County ..... Woodland
R. A. Tinnin, Warden, Yuba County ..... Browns Valley

### Southern Division

S. R. Gilloon, Captain in Charge ..... Fresno
Robert Cowell, Warden, Flying Squad ..... Calwa City
J. W. Thornburg, Warden, Flying Squad ..... Tracy
John O'Connell, Captain ..... Stockton
E. O. Wraith, Captain ..... Bakersfield
R. J. Little, Warden, Amador County ..... Jackson
L. R. Garrett, Warden, Calaveras County ..... Murphys
F. A. Bullard, Warden, Fresno County ..... Reedley
Paul Kehrer, Warden, Fresno County ..... Fresno
Lester Arnold, Warden, Kern County ..... Bakersfield
Roswell Welch, Warden, Kern County ..... Kernville
Ray Ellis, Warden, Kings County ..... Hanford
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Gilbert T. Davis, Warden, Mariposa County ..... Mariposa
M. S. Clark, Warden, Merced County ..... Merced
C. S. Donham, Warden, Merced County ..... Gustine
Wm. Hoppe, Warden, San Joaquin County ..... Lodi
Geo. Magladry, Warden, Stanislaus County ..... Modesto
R. J. Bullard, Warden, Tulare County ..... Porterville
W. I. Long, Warden, Tulare County ..... Visalia
F. F. Johnston, Warden, Tuolumne County ..... Sonora

## COAST DISTRICT (Headquarters, San Francisco)

K. P. Allred, Inspector in Charge ..... San Francisco

## Northern Division

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R. Remly, Warden, Flying Squad—Willits
R. E. Tutt, Warden, Flying Squad—Willits
J. D. Dondero, Captain—Eureka
Henry Lencioni, Captain—Santa Rosa
Ray Diamond, Warden, Del Norte County—Crescent City
John Hurley, Warden, Humboldt County—Eureka
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## Southern Division

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Orben Philbrick, Warden, Monterey County—King City
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C. R. Peek, Warden, San Mateo County—San Mateo
C. E. Holladay, Warden, Santa Clara County—San Jose
F. J. McDermott, Warden, Santa Cruz County—Santa Cruz

## Marine Fisheries Detail (Coast District)

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Kenneth Hooker, Warden, Cruiser *Quinnat III*—San Francisco
Nathan Rogan, Assistant Warden, Cruiser *Quinnat III*—San Francisco
C. Apsley, Assistant Warden, Launch *Sturgeon*—Martinez
J. W. Cowan, Assistant Warden, Launch *Sturgeon*—Martinez
Leslie E. Lahr, Warden—Eureka
Charles Mayfield, Warden—Monterey
G. R. Smalley, Warden—Richmond
Ralph Miller, Warden—San Francisco
Charles Holzhouser, Warden—Watsonville

## SOUTHERN DISTRICT (Headquarters, Los Angeles)

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## Western Division

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————, Captain—Bishop
————, Captain—Banning
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C. J. Walters, Warden, Inyo County—Independence
Al Crocker, Warden, Mono County—Bridgeport
J. H. Gyger, Warden, Riverside County—Perris
R. C. O'Conner, Warden, Riverside County—Banning
W. C. Malone, Warden, San Bernardino County—San Bernardino
W. S. Talbott, Warden, San Bernardino County—Big Bear Lake

## Marine Fisheries Detail (Southern District)

C. H. Groat, Captain in Charge——Terminal Island
Lars Weseth, Master, M. V. *N. B. Scofield*——Terminal Island
Walter Engelke, Master, M. V. *Bluefin*——Terminal Island
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Kenneth Webb, Assistant Warden, Cruiser *Bonito*——Santa Barbara
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L. R. Metzgar, Assistant Warden, Cruiser *Broadbill*——Santa Monica
————, Warden, Cruiser *Marlin*——San Diego
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John Barry, Assistant Warden, Cruiser *Tuna*——Avalon
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H. Ocker, Assistant Warden, Cruiser *Yellowtail*——Balboa
Lester Golden, Warden——Arroyo Grande
T. J. Smith, Warden——San Diego
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Donald Glass, Warden——Terminal Island
Erol Greenleaf, Warden——Terminal Island
N. C. Kunkel, Warden——Terminal Island
Tate F. Miller, Warden——Terminal Island
T. W. Schilling, Warden——Terminal Island
L. G. Van Vorhis, Warden——Terminal Island

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J. A. Reutgen, Assistant Warden, Launch *Rainbow*——Stockton
R. Schoen, Warden——Terminal Island
H. A. Erwick, Assistant Warden——Terminal Island
E. A. Johnson, Assistant Warden——Terminal Island

## CALIFORNIA JUNIOR GAME PATROL

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Geo. D. Seymour, Assistant, Junior Game Patrol——San Francisco

## MARINE PATROL AND RESEARCH

Motor Vessel *N. B. Scofield*, Terminal Island
Motor Vessel *Bluefin*, Terminal Island
Cruiser *Yellowtail*, Newport Harbor
Cruiser *Broadbill*, Santa Monica
Cruiser *Quinnat III*, San Francisco
Cruiser *Bonito*, Santa Barbara
Cruiser *Marlin*, San Diego
Cruiser *Tuna*, Avalon
Launch *Rainbow*, Stockton
Launch *Shrapnel*, Lakeport
Launch *Sturgeon*, Martinez
Launch *Perch*, Sacramento

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